

REVISION OF THE CASSIINAE IN AUSTRALIA.
1. *SENNA* MILLER SECT. *CHAMAEFISTULA*
(COLLADON) IRWIN AND BARNEBY

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Abstract

Information is presented supporting the division of *Cassia* L. into three genera, and as a result sect. *Chamaefistula* is treated within *Senna* Miller. Nine species are shown to have been introduced to Australia. The endemic taxa have been revised and are now recognised as three species, one of which has been raised from varietal rank. New combinations are provided for *Senna barclayana* (Sweet) Randell, *Senna clavigera* (Domin) Randell and *Senna planitiicola* (Domin) Randell.

I. Introduction

This is the first in a series of papers in which it is hoped to revise all the members of the Cassiinae (i.e. *Cassia* L. sens. lat.) which are known to occur in Australia.

Irwin and Barneby (1982) raised the genus *Cassia* L. sens. lat. to the level of subtribe, and elevated the previous subgenera to generic rank. They thus reinstated *Senna* Miller and *Chamaecrista* Moench. Included here is a list of the characters on which that decision was based, together with a statement of the reasons for its acceptance here.

This paper deals with *Senna* sect. *Chamaefistula* comprising 12 species recorded in Australia, but only 3 of these are native. Of the remainder 5 are cultivated garden plants, some of which have become naturalised, and 4 are known only as weeds.

There are few taxonomic problems among these species. Names have been misapplied among the cultivated plants and this situation is clarified. In eastern Australia, there has been some confusion involving the two varieties of *S. barclayana*, and this has been resolved by preparing a new circumscription of the type variety and recognising a second species.

In this paper no attempt has been made to give full synonymy for the American species, as these details are available in Irwin and Barneby (1982). However, all names known to have been used in Australia are included.

II. THE GENUS *CASSIA*

1. Introduction

The genus *Cassia* L. is the largest genus in the subfamily Caesalpinioideae of the Leguminosae, and is probably one of the twentyfive largest genera of dicotyledons (Irwin and Turner 1960). The first comprehensive review of the genus was made by Colladon (1816), followed by Vogel (1837). A major revision was published by Bentham (1871), with the Malesian species treated by De Wit (1955) and African species by Brenan (1967). Australian species were revised by Symon (1966). Over many years, American species have been closely studied by Irwin and co-workers Turner and Barneby (e.g. Irwin and Turner 1960; Irwin and Barneby 1976a, 1976b, 1982).

In discussions of the taxonomy of the Caesalpinioideae, Cowan (1981), and Polhill and Vidal (1981) have shown that *Cassia* L. sens. lat. is in fact recognised by the absence of a number of characters. In the Caesalpinioideae, numerous small natural groups (tribes and

subtribes) have each been defined by a few conspicuous morphological characters (Table 1). The residuum of species is recognised as *Cassia* L. sens. lat., even though the only characters common to all species are those which are important at the family or subfamily level, i.e. 5-merous; more or less zygomorphic flowers; single carpel; paripinnate leaves. A very great range of variation is accepted in all other characters in, e.g. plant habit; number of leaflet pairs; size of leaflets; number and arrangement of foliar and other extrafloral glands; root nodulation; form and venation of sepals; colour of petals; number and dehiscence of fertile anthers; length and arrangement of anther filaments; characteristics and dehiscence of legumes; seed funicle structure etc.

In these circumstances, it is highly unlikely that *Cassia* sens. lat. represents a single evolutionary line.

Table 1. Characters used in the delimitation of tribes and subtribes of the subfamily Caesalpinioideae (data from Cowan 1981 and Polhill and Vidal 1981).

Character	Taxon so defined	Conditions in subtribe Cassiinae
	Tribe	
Sepals fused to hypanthium	Cercideae	Sepals never fused
Hypanthium tubular or long and infilled	{Caesalpinieae Detarieae Amherstieae	Hypanthium not tubular, nor long and infilled
Anthers opening by long slits	Caesalpinieae	Anthers opening by pores or short slits
Leaves bipinnate, or imparipinnate, or simple by reduction	Caesalpinieae	Paripinnate, very rarely phyllodinous by reduction
Leaves palmately lobed	Cercideae	Leaves never palmate
Stipules intrapetiolar	{Detarieae Amherstieae Other subtribes of tribe Cassieae	Stipules never intrapetiolar
Pod drupaceous or indehiscent and winged	Dialiinae	Pod never drupaceous nor both indehiscent and winged
Flowers apetalous, usually dioecious	Ceratoniiinae	Flowers with petals, hermaphrodite
Stamens fused into a synangium	Duparquetiinae	Stamens free
Androecium of 2-3 anthers	Labicheinae	Androecium of 5, 6, 7 or 10 anthers.

2. The lectotype of *Cassia* L.

The current lectotype, *C. fistula* L., chosen by Britten and Brown (1913) and accepted by the International Botanical Congress (1930), agrees with the protologue descriptions of calyx, corolla, pistil, fruit and seed. However, it does not agree with the detailed description of the anthers, as the three large abaxial anthers of *C. fistula* are not beaked, are not larger than the laterals, are on filaments which are sigmoidally curved not arcuate, and are dehiscent by both basal and apical pores (see e.g. Irwin and Barneby 35: 64, (1982). There is thus a conflict between the protologue, which describes the androecium of *Senna* Miller, and the current lectotype, *C. fistula*.

However, it is clear that Linnaeus (1737) intended to apply the name *Cassia* in the sense of *C. fistula*. Almost all later workers (e.g. Colladon, 1816; Vogel 1837; Bentham 1871; De Wit 1955; Brenan 1967; Symon 1966) have also used the name in the sense of *C. fistula*. In the interests of stability, it has been proposed that the genus *Cassia* be conserved with the currently accepted lectotype, *C. fistula*. A manuscript embodying this proposal has been accepted for publication (Randell, *Taxon*, in press).

3. Earlier taxonomic treatments

The protologue of *Cassia* L. (1737, 1754) makes it clear that Linnaeus included within the one genus plants that had previously been placed in at least three separate genera, i.e. *Cassia*, *Senna* and *Chamaecrista*. In this decision Linnaeus disagreed with a long herbal tradition.

Matthioli (1554) and Dodonaeus (1553) (both cited in De Wit 1955), and Miller (1754) all recognised two entities, 'cassia' with long woody indehiscent pods whose pith was used as a purgative, and 'senna' with short flat dehiscent pods and associated leaves, also used as a purgative.

Breyne (1678) described several species in 'cassia', 'chamaecassia' (equivalent to 'senna') and 'chamaecrista'. He was obviously convinced that the entities were different.

Tournefort (1700) maintained herbal practice by using both names 'cassia' and 'senna', but Linnaeus, while acknowledging his debt to Tournefort, used *Cassia* for the whole group and reduced both 'senna' and 'chamaecrista' to synonymy (1753, 1754).

Linnaeus' decision was not universally adopted, e.g. Miller (1754) chose to continue to use the name *Senna* for the plant which had always carried that name in herbals. He was followed in many details by Garsault (1769), Gaertner (1791) and Roxburgh (1832). On the other hand, Lamarck (1785), Colladon (1816), Vogel (1837), Bentham (1871) and most modern workers followed Linnaeus.

One of the strongest arguments in favour of Linnaeus' approach was the absence of known characters which would always separate the three subgroups whose presence within *Cassia* sens. lat. was acknowledged by virtually all workers. For example Bentham (1871) based his classification on pod structure. However, structure of the pods does not always correlate well with other important characters, e.g. of the androecium, and his classification was not entirely satisfactory.

Success in the delimitation of the subgroups was achieved when Irwin and Barneby (1982) recognised the suite of characters listed in Table 2. These primarily concern the androecium and are illustrated in Plate 1. Correlations between the characters are very strong and persist in the Americas (Irwin and Barneby 1982), in India (Roxburgh 1832), in Africa (Brenan 1967) and Australia (Randell, unpublished).

Table 2. Characters defining the three genera recognized by Irwin and Barneby (1982).

	Cassia	Senna	Chamaecrista
Androecium	Bilaterally symmetrical	Bilaterally symmetrical	Never bilaterally symmetrical
	Lower whorl sigmoidally elongate	Upper whorl elongate, not sigmoidally	Never elongate
	All versatile	None versatile	None versatile
	Some basal pores	All apical pores	All apical pores
	Never beaked	Sometimes some beaked	Never beaked
Pods	Woody indehiscent	Flattened dehiscent (Or terete, pithy) (Or woody indehiscent but then leaf glands present)	Elastically dehiscent
Leaf glands	Absent	Present or absent	Present or absent
Inflorescence	Terminal	Axillary	Axillary
Floral bracteoles	Present	Absent	Present
Root nodules	Absent	Absent	Sometimes present

As it is considered unlikely that *Cassia* sens. lat. represents a single evolutionary line (see above), and the subgroups within it are separated by a suite of significant characters which are strongly correlated over wide geographic areas, the three subgroups are considered as separate genera in the revision which follows.

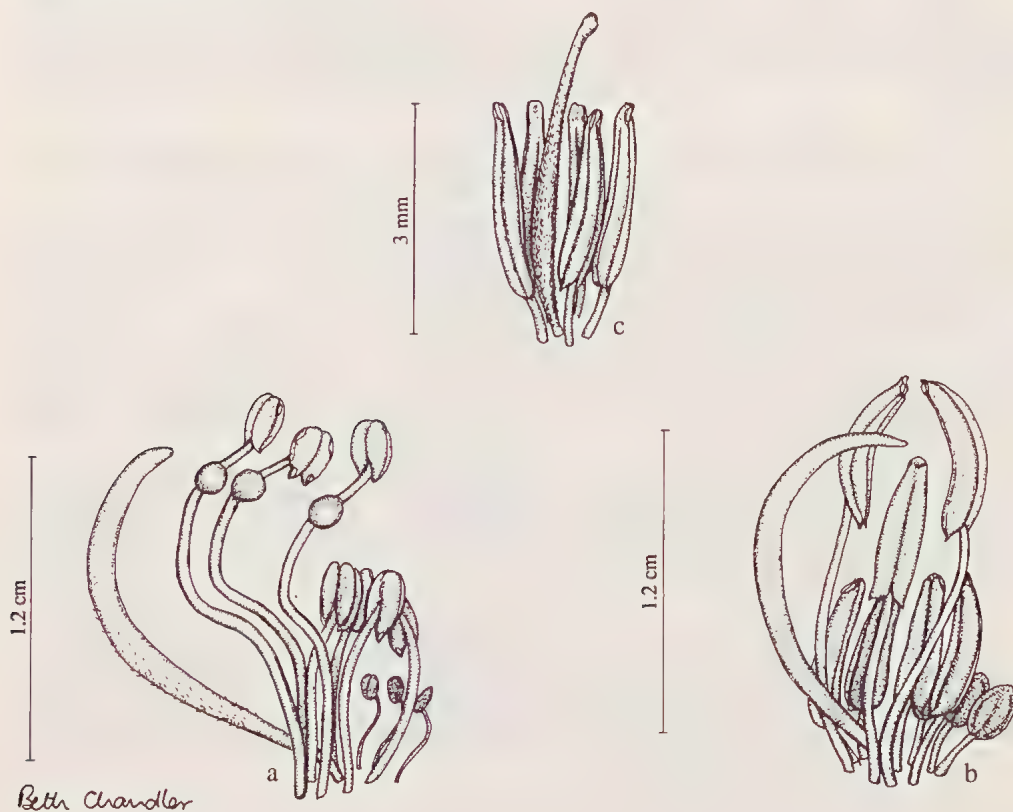


Plate 1. a, androecium of *Cassia brewsteri* (from Messner s.n., ix.1962 AD); b, androecium of *Senna* \times *floribunda* (from Ashby 2829, AD); c, androecium of *Chamaecrista* sp. (from Latz 60, AD).

4. Key to the genera of subtribe *Cassiinae*

1. Androecium not zygomorphic; sepals acute; floral bracteoles 2; pod elastically dehiscent, the valves coiling spirally *Chamaecrista*
1. Androecium weakly to very strongly zygomorphic; sepals obtuse; floral bracteoles 0 or 1; pod never elastically dehiscent:
 2. Inflorescences terminal; floral bracteole 1; longest anther filaments sigmoidally curved; anthers versatile, some dehiscent by both basal and apical pores, never beaked; pods cylindrical woody and indehiscent; leaves eglandular *Cassia*
 2. Inflorescences axillary; floral bracteole 0; longest anther filaments arcuate; anthers basifixed, dehiscent only by apical pores, sometimes beaked; pods variable, flat or cylindrical, with coriaceous valves and dehiscent, or cylindrical woody and indehiscent (but then leaves glandular); leaves glandular or not *Senna*

III. SENNA

Senna Miller, *Gard. Dict. Abr. edn 4*, vol. 3. (1754). Gaertner, *Fruct. sem. pl.* 2, 312 (1791); Link, *Handbuch* 2:139 (1831); Roxb., *Fl. Ind. ed. Carey*, 2:339 (1832); Irwin and Barneby, *Mem. New York Bot. Gard.* 35:64 et seq. (1982).

Lectotype: “*Senna Alexandrina* sive foliis acutis C(aspar) B(auhin) P(inax 397)”, equivalent to *Senna alexandrina* Miller 1768. Fide Irwin and Barneby, *Mem. New York Bot. Gard.* 35:64, (1982).

Synonyms and selected bibliography

1. *Cassia* sensu Persoon, *Syn. pl.* 1:459 (1805); Willdénow, *Enum. pl. horti Berol.* :439 (1809), non L.
2. *Cassia* L. sect. *Senna* (Miller) DC. ex Colladon, *Hist. nat. méd. Casses* 92 (1816); Benth. in Bentham and Hooker, *Gen. pl.* 1:139 (1865).
3. *Cassia* L. subgen. *Senna* (Miller) Benth. in Martius, *Fl. Bras.* 15:96 (1870); Benth., *Trans. Linn. Soc. London* 27:513 (1871); Symon, *Trans. Roy. Soc. S. Australia* 90: 76 (1966).

Characteristics of the genus

Anthers basifixed, several of the upper whorl on longer arcuate (never sigmoidal) filaments, all truncate or sometimes some produced into beaks, all ten fertile or more often seven abaxial fertile and three adaxial reduced to staminodes, opening only by apical pores or short slits; floral bracteoles absent; pods flat or cylindrical with coriaceous valves and opening by slow degeneration (never elastically dehiscent) or rarely cylindrical and indehiscent (but then leaves always with rachis glands); seed funicles filiform; root nodules absent (Table 2).

Key to the sections and series of *Senna* Miller in Australia

1. Pods cylindrical with pith; leaves always glandular 1. sect. *Chamaefistula*
2. Glands at base of petiole 1b. ser. *Basiglandulosae*
2. Glands between leaflet pairs:
 3. Shrubs; leaflets (3-) 4-6 pairs; seeds without areoles 1a. ser. *Coluteoideae*
 3. Herbs; leaflets 1-3 pairs; seeds with areoles 1c. ser. *Trigonelloideae*
1. Pods cylindrical and leaf rachis eglandular, or pods flat:
 4. Fertile anthers 7 often beaked; 2 or 3 abaxial anthers markedly larger and borne on filaments often elongate and widely divergent; leaf rachis usually without glands 2. sect. *Senna*
 4. Fertile anthers 10 (rarely 7), truncate, subequal; filaments short, straight, 3 abaxial barely elongate; leaf rachis with glands between leaflet pairs 3. sect. *Psilorhegma*

Notes

1. The sections *Senna* and *Chamaefistula* are separated by Irwin and Barneby (1982) primarily on the disposition of the long abaxial anther filaments — whether parallel with (sect. *Chamaefistula*) or perpendicular to (sect. *Senna*) the plane of floral symmetry. While this character is clear in fresh flowers it is almost impossible to determine in dried materials, making identification of herbarium specimens difficult. The above key therefore makes use of correlated characters, to allow the identification of species likely to be encountered in Australia.

2. Ser. *Florideae* was placed in sect. *Chamaefistula* by Irwin and Barneby (1982), solely on the disposition of its anther filaments, (i.e., without obvious correlated characters). It is considered that this places unacceptable weighting on a single character. In this revision, ser. *Florideae* will be treated as part of sect. *Senna*, thus following Bentham (1871). Identification of characters correlated with anther filament disposition would reverse this decision.

1. *Senna* sect. *Chamaefistula*

Senna Miller sect. *Chamaefistula* (Colladon) Irwin and Barneby, *Mem. New York Bot. Gard.* 35:82 (1982).

Lectotype: *Cassia coluteoides* Colladon, *Hist. nat. méd. Casses* 102, t. 12 (1816) fide Irwin and Barneby op. cit. p. 382, a synonym of *Senna pendula* (Willd.) Irwin and Barneby var. *glabrata* (J. Vogel) Irwin and Barneby, op. cit. p. 382.

Note: Irwin and Barneby (loc. cit. p. 82) designated ser. *Coluteoideae* as the type of the section. Hence the lectotype of that series must also be the lectotype of the whole section. The species in question is *Cassia coluteoides* Colladon not, as suggested by Irwin and Barneby (loc. cit. p. 82) *Cassia corymbosa* Lam.

Selected synonyms and bibliography

1. *Cassia* L. sect. *Chamaefistula* DC. ex Colladon, *Hist. nat. méd. Casses* 21 (1816).

Description

Defined by Irwin and Barneby (1982) as having the characteristics of the genus and in addition, the two long abaxial filaments parallel to or at a small angle from each other, and in the plane of symmetry of the zygomorphic androecium. In addition, Australian species have acicular caducous stipules, glandular leaf rachises, and cylindrical pithy pods with coriaceous valves.

1a. Ser. *Coluteoideae*

Senna Miller [sect. *Chamaefistula* (Colladon) Irwin and Barneby] ser. *Coluteoideae* (Colladon) Irwin and Barneby, *Mem. New York Bot. Gard.* 35:345 (1982).

Lectotype: *Cassia coluteoides* Colladon, *Hist. nat. méd. Casses* 102, t. 12 (1816), a synonym of *Senna pendula* (Willd.) Irwin and Barneby var. *glabrata* (J. Vogel) Irwin and Barneby, *Mem. New York Bot. Gard.* 35:382 (1982).

Selected synonyms and bibliography

1. *Cassia* L. sect. *Chamaesenna* Colladon ser. *Coluteoideae* Colladon, *Hist. nat. méd. Casses* 98 (1816).

2. *Cassia* L. sect. *Senna* (Miller) Colladon subsect. *Chamaefistula* (Colladon) Benth. in Benth. & Hooker, *Gen. pl.* 1, 572 (1865).

3. *Cassia* L. subgen. *Senna* (Miller) Benth. sect. *Chamaefistula* Colladon ser. *Corymbosae* Benth. in Martius, *Fl. Bras.* 15, 2:106 (1870); *Trans. Linn. Soc. London* 27:525 (1871).

Lectotype: *Cassia corymbosa* Lam. a synonym of *Senna corymbosa* (Lam.) Irwin and Barneby, *Mem. New York Bot. Gard.* (op. cit. p. 397).

Description

Defined by Irwin and Barneby (1982) as having a zygomorphic corolla, numerous ovules (25-150), and exarcolate seeds turned broadside to the septae of the pod. Most Australian species have coriaceous leaflets, however those of *S. × floribunda* are thinner and become flaccid on wilting.

Key to Australian species of ser. *Coluteoideae* (all species below are introduced, some naturalised)

1. Plants with all parts tomentose; leaflets revolute; glands 3-5 between leaflet pairs. Sparsely naturalised in southern Australia 2. *S. multiglandulosa*

1. Plants glabrous or very sparsely pubescent; leaflets flat; glands 1-2 between leaflet pairs:
 2. Leaflet apex acuminate; leaflets not coriaceous, becoming flaccid on wilting. Naturalised in eastern subtropical Australia 1. *S. × floribunda*
 2. Leaflet apex not acuminate; leaflets coriaceous, but often folding inwards when wilting:
 3. Leaflets 2-4 pairs lanceolate; fertile anthers 7, central abaxial anther plump; anthers biporose. Hardly naturalised 5. *S. corymbosa*
 3. Leaflets 3-6 pairs elliptic to obovate; fertile anthers 6, central abaxial anther shrunk or much reduced; anthers with a single U-shaped pore:
 4. Leaflets broadest at or below the middle, folding forward in sleep; pedicels not more than 1.0 cm long. Not naturalised 4. *S. bicapsularis*
 4. Leaflets broadest at or above the middle, not folding or drooping; pedicels usually more than 1.0 cm long. Weedy in eastern subtropical Australia 3. *S. pendula* var. *glabrata*

1. *S. × floribunda* (Cav.) Irwin and Barneby, *Mem. New York Bot. Gard.* 35:360 (1982); De Wit, *Webbia* 11, 245 (1955); Symon, *Trans. Roy. Soc. S. Australia* 90:86 (1966); Stanley and Ross, *Fl. S-e Queensland* 1:391 (1983); Beadle, Evans and Carolin, *Fl. Sydney Region* 276 (1976).

Lectotype: "Crece en la Nueva-España junto a la Puebla de los Angeles (Puebla, Mexico) . . . se cultiva en el Jardín botánico" i.e. cultivated in Madrid, "sent as *C. floribunda* ex. hort. matrit. by Lagasca in 1807 to De Candolle", now in G-DC, fide Irwin & Barneby loc. cit.

Selected synonyms and bibliography

1. *Cassia corymbosa* Gomez Ortega, *Nov. pl. descr. dec.* 10:124 (1800) (nomen illeg.: non Lam. 1785).

Lectotype: as *S. floribunda* above, fide Irwin and Barneby loc. cit.

2. *Cassia floribunda* Cav., *Descr. pl.* 132 (1801).

Lectotype: as above.

3. *Cassia laevigata* sensu Benth., *Fl. Austral.* 2:282 (1864); Benth., *Trans. Linn. Soc. London* 27:527 (1871); sensu Bailey, *Fl. Queensland* 2, 457 (1900), non Willd.

Description

Shrub 1-3 m tall; leaves 6-8 cm long, apparently glabrous; *leaflets* 4-5 pairs, ovate, 1.5-3 cm apart on the rachis, the largest 4.5-7 x 1.5-2.8 cm, increasing in size from the base of the rachis, apex acuminate, base symmetrical, glabrous, midrib prominent below, concolorous; *glands* 3-4 between lowest pairs of leaflets, erect and club-shaped; *petiole* 1.5-3 cm long, terete; *inflorescence* racemose with 5-8 flowers; *peduncle* 3-4 cm; *pedicel* of open flower 1-1.3 cm long; *bracts* caducous; *flowers* 1.5-1.8 cm diam. when open; *sepals* lanceolate to obovate; unequal to 8 mm long; *petals* obovate, yellow, to 8 mm long; *androecium* of 3 adaxial staminodes and 7 rarely 6 fertile anthers, 3 abaxial anthers largest to 6 mm long with central anther (sometimes shrunk) on filament 2 mm long, the 2 plump lateral anthers on filaments 8 mm long; *ovary* glabrous; *fruiting peduncle* 4-5 cm long; *fruiting pedicel* 1.5-2.5 cm, robust; *pod* 7-8 x 1.5 cm diam. with blunt tip; not all ovules developing to form mature seeds so pod often partly empty and irregular in shape; *seeds* olive green and glossy, obovate. Plate 2a-e.

Distribution and Ecology

Probably introduced as a garden specimen, now naturalised and weedy in pasture or rainforest over extensive areas of subtropical coastal New South Wales and Queensland, first collected near Brisbane in 1856 (Symon 1966 not seen). Map 1.



Plate 2. a-e, *S. × floribunda*. a, habit; b, pod; c, largest anther (lateral abaxial); d, median anther; e, adaxial staminode (all from *Ashby* 2829, AD). f-j, *S. multiglandulosa*; f, habit (from *Fisher* 68, AD); g, pod (from *Brink* 542, AD); h, largest anther (lateral abaxial); i, median anther; j, adaxial staminode (all anthers from *Symon* s.n., 22.x.1959, AD).

Notes

1. Identified by Irwin and Barneby (1982), as of hybrid derivation from *S. septemprionalis* (Viv.) Irwin and Barneby and *S. multiglandulosa* (Jacq.) Irwin and Barneby, where these are sympatric in areas of Mexico (Irwin and Barneby op. cit. p. 362). This hybrid origin may explain the irregular seed set described above. However in Australia it acts as a good taxon, showing little morphological variation and setting viable seeds.

2. In this and all future descriptions the character *peduncle* refers to the length of the axis below the lowest flower.

Specimens seen (24 sheets):

QUEENSLAND: Banks of Logan R., near Waterford, *Willis s.n.*, 23.v.1981 (MEL); Maleny, *Randell 283*, 8.ix.1985, (ADU, 6 sheets).

NEW SOUTH WALES: Ca 10 km NW of Upper Colo, *Donner 7761*, 3.i.1981 (AD); between Batemans Bay and Braidwood Rd., *Orchard 4511*, 8.ii.1975 (AD); 18 km W Mullumbimby, *Randell 274*, 3.ix.1985 (ADU, 2 sheets); roadside, central Bucca, *Randell 270*, 2.ix.1985 (ADU); Dorn Dorn, Tweed Valley, *Kooyman s.n.*, 1986 (ADU); roadside 2 km E Copeland, *Randell 286*, 16.xii.1985 (ADU); Bulli, *Morris s.n.*, 25.ix.1927 (AD); Epping, *Rainbow s.n.*, 29.xii.1928 (AD); Georges R. Reserve Ingleburn, *McBarron 14180*, 29.iv.1967 (AD); 'Brit Brit' near Balmoral/Coleraine, *Beaulehole 49776*, 24.iii.1975 (AD); "Woollongong", *Macpherson 125*, 1889 (MEL); Nowra, *Rupp s.n.*, .xii.1915 (MEL); Bulladelah, *Rupp s.n.*, .v.1923 (MEL).

SOUTH AUSTRALIA: Adelaide, Marion, cult. in home garden, *Randell 296*, 3.iv.1986 (ADU, 2 sheets); Blackwood, cult., *A.M. Ashby 2829*, 25.iii.1969 (AD).

2. *S. multiglandulosa* (Jacq.) Irwin and Barneby, *Mem. New York Bot. Gard.* 35:357 (1982).

Holotype: "cult. in hort schoenbrun., semina a Massone accepi, qui in hortis Tenerifae crescentem invenit" W (hb Jacq.) fide Irwin and Barneby loc. cit.

Selected synonyms and bibliography

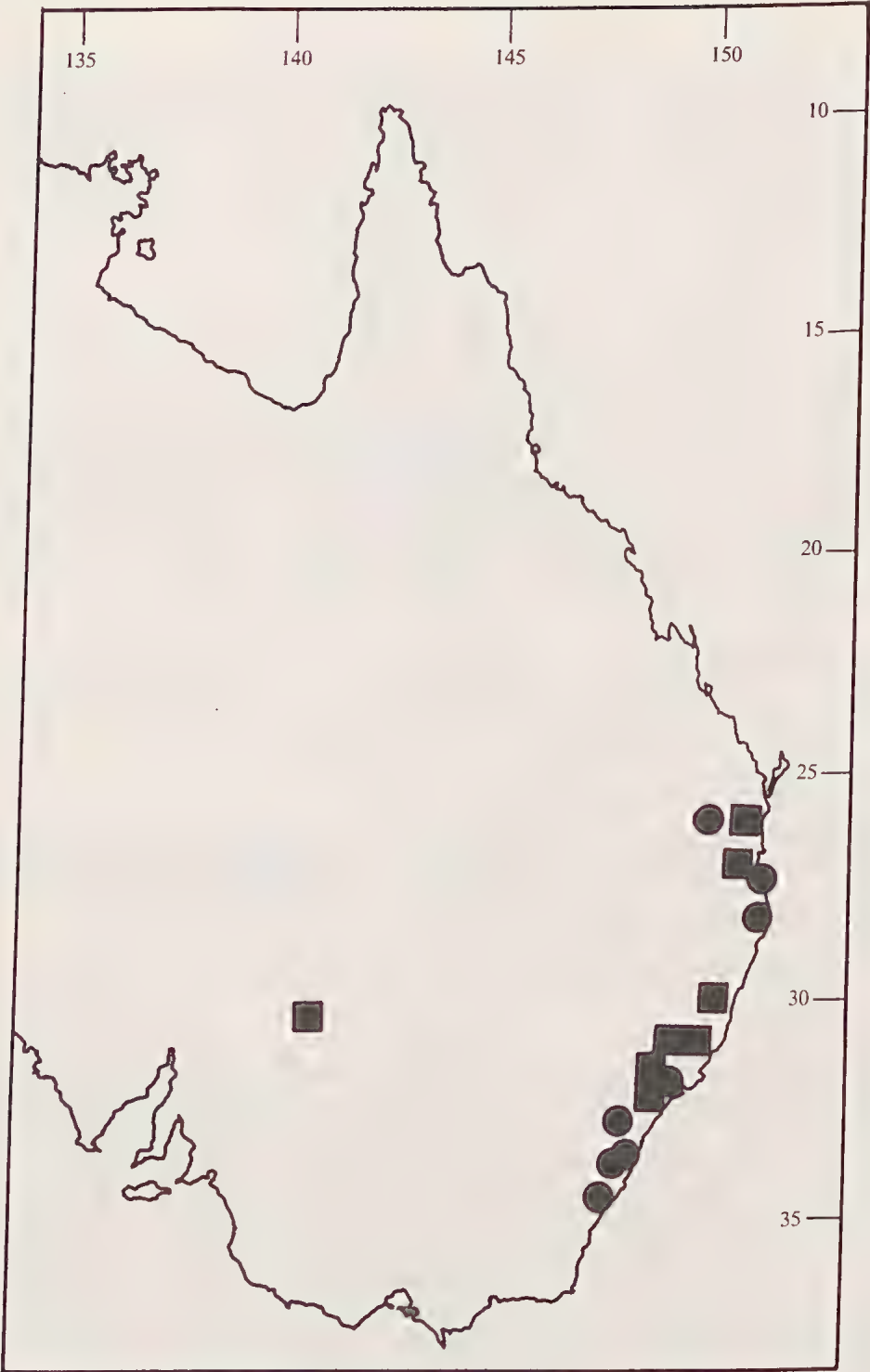
1. *Cassia tomentosa* L.f., *Suppl. pl.* 231 (1781); Benth., *Trans. Linn. Soc. London* 27:528 (1871); De Wit, *Webbia* 11:275 (1955); Symon, *Trans. Roy. Soc. S. Australia* 90:87 (1966), non *Senna tomentosa* Batka, *Bot. Zeitung* 11:193 (1849).

Holotype: LINN 528/23 fide Irwin and Barneby, op. cit. p. 357.

2. *Cassia multiglandulosa* Jacq., *Icon. pl. rar.* 1:8, t. 72 (1783).

Description

In cultivation, tall shrub or small tree to 4 m, the stem usually glabrescent and sometimes angular; *leaves* 6-8 cm including the petiole; *leaflets* 6-8 pairs, linear to lanceolate, 0.8-1.2 cm apart on the rachis, the largest 2-3 x 0.8-1.2 cm, increasing in size from the base of the rachis, apex acute and mucronate, base asymmetric, with dense short erect hairs adaxially, and yellow villous abaxially, veins yellowish abaxially, green adaxially, paler abaxially; *glands* 2-4, dark, erect and pointed, between the lowest leaflet pairs; *petiole* 0.8-1.2 cm long, terete; *inflorescence* racemose, bearing 10-20 flowers; *peduncle* 2-3 cm long; *pedicel* of open flower 1.0-1.2 cm long; *bracts* caduous; *flowers* 2.5 cm in diam.; *sepals* lanceolate to obovate, unequal in length to 1.0 cm long, villous; *petals* broad obovate, yellow, the largest 1.0-2.0 cm long; *androecium* of 3 adaxial staminodes, and 7 fertile anthers, 3 abaxial anthers largest to 7 mm long, with central anther on filament 6 mm long, the 2 lateral anthers on filaments 8 mm long; *ovary* with long dense semierect shining white hairs; *fruiting peduncle* 2-3.5 cm long; *fruiting pedicel* 1.8-2.5 cm long; *pod* 6-8 x 0.8 cm, with a persistent style, pilose; *seeds* olive-green, obovate. Plate 2f-j.



Map 1. Distribution of *S. x floribunda* ● and *S. pendula* var. *glabrata* ■

Distribution and ecology

Probably introduced as a garden specimen. Now sparingly naturalised in SE South Australia, SW Victoria, and border areas between Victoria and New South Wales.

Note

Identified by Irwin and Barneby (1982) as naturally distributed in upland areas of Mexico and much of South America.

Specimens seen (14 sheets):

NEW SOUTH WALES: 27 km from Victorian border towards Eden, *Canning* 1239, 30.vi.1968 (AD); East Boyd, *Gray* 5675, 28.i.1965 (AD).

VICTORIA: Battery Pt area, Portland, *Beaglehole* 5214, 20.ii.1962 (MEL,AD); Lakes Entrance, *Robbins* s.n., c. 1937 (MEL); Snowy R. at Bete Bolong, east Gippsland, *Geary* s.n., 15.vii.1985 (MEL); Snowy R., 1.0 km N of Bete Bolong turnoff, *van Rees* 028, 17.viii.1979 (MEL).

SOUTH AUSTRALIA: Foot of Mt Shank, S of Mt Gambier, *Randell* 330, -v.1986 (ADU, 3 sheets); Mil Lel, near Mt Gambier, *Symon* s.n., 2.xii.1971 (AD, 2 sheets); Riverton, home garden, *Symon* s.n., 22.x.1959 (AD); Furner, cult garden shrub, *Fisher* 68, -x.1974 (AD).

3. *S. pendula* (Willd.) Irwin and Barneby, *Mem. New York Bot. Gard.* 35:378 (1982) var. *glabrata* (J. Vogel) Irwin and Barneby, op. cit., p.382).

Neotype and presumed isotype: "In Brasilia: Sellow legit pr. Ypanema (São Paulo) K." fide Irwin and Barneby, loc. cit.

Selected synonyms and bibliography

1. *Cassia coluteoides* Colladon, *Hist. nat. méd. Casses* 102, t. 12 (1816); De Wit, *Webbia* 11:239 (1955); Symon, *Trans. Roy. Soc. S. Australia* 90:85 (1966).

Lectotype: "an old cultivated specimen dating back to De Candolles years at Montpellier, the stock acquired from Lisbon", MPU, fide Irwin and Barneby, loc. cit.

2. *Cassia crassisejala* Benth., *Linnaea* 22:527 (1849).

Holotype: Regnell 76 of collection II K (hb Benth.), not seen.

3. *Cassia bicapsularis* sensu Benth. in Martius, *Fl. Bras.* 15:107 (1870); Benth., *Trans. Linn. Soc. London* 27:525 (1871) p.p. as for *C. coluteoides*.

Description

Spreading shrub to 3 m tall; *leaves* 4-8 cm long including petiole, very sparsely hairy; *leaflets* 3-6 pairs, oblanceolate to obovate, 1-2 cm apart on the rachis, the largest 2-5 x 1-1.5 cm, increasing in size from the base of the rachis, apex usually obtuse, rarely emarginate, base unequal, veins not obvious, concolorous; *gland*, 1 clavate, between lowest pair of leaflets, green; *petiole* 2-4 cm long, terete; *inflorescence* racemose, of 15-20 flowers; *peduncle* 3-4 cm long; *pedicel* of open flower 2-2.5 cm long; *bracts* usually caducous; *flower* 2.5-3 cm in diam.; *sepals* lanceolate to obovate, unequal in length, to 1.0 cm long; *petals* obovate, emarginate, yellow, the longest to 1.5 cm; *androecium* of 3 adaxial stamenes and 6 or 7 fertile anthers, the 3 abaxial anthers the longest to 8 mm, with central anther (sometimes shrunken) on filament 4 mm long and the 2 lateral anthers on filaments 15 mm long, dehiscent by one U-shaped pore; *ovary* almost glabrous; *fruiting peduncle* 3-6 cm long; *fruiting pedicel* to 3 cm long; *pod* 10-14 x 1.0 cm; *seeds* olive-green, oval, asymmetrical. Plate 3d-f.

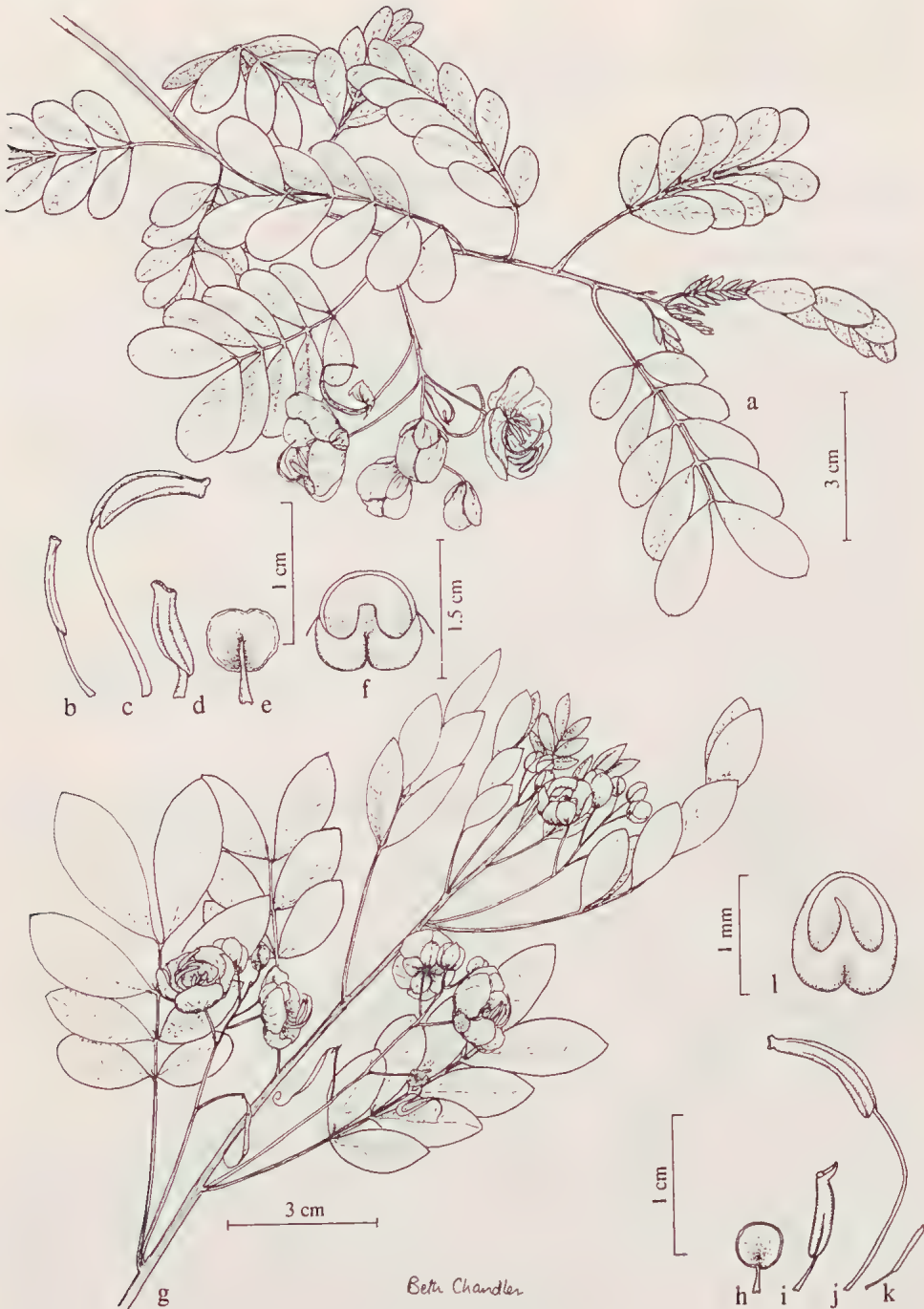


Plate 3. a-f, *S. pendula* var. *glabrata*, a, habit (from living material, cult. Adelaide. Randell 297. (ADU) and JWR (sic) s.n., AD); b, central abaxial staminode; c, largest anther (lateral abaxial); d, median anther; e, adaxial staminode; f, single pore of largest anther (all anthers from JWC (sic) s.n., AD). g-k, *S. bicapsularis*, g, habit, h, adaxial staminode; i, median anther; j, largest anther (lateral abaxial); k, central abaxial staminode; l, single pore of largest anther (all from Kiesing 3397 (AD) ex South America).

Distribution and Ecology

Probably introduced as a garden specimen, now extensively naturalised in coastal areas of northern New South Wales. Map 1.

Note

Identified by Irwin and Barneby (1982) as native of forest margins of large areas of Brazil.

Specimens seen (24 sheets):

QUEENSLAND: Mt Buderim, *Pederson s.n.*, -iv.1931, (AD); Ipswich, naturalised, *Pedley 4567*, 10.iv.1979 (MEL).

NEW SOUTH WALES: Broken Hill, cult., *Cooper s.n.*, -v.1928, (AD); E of Bowmans, N of Gloucester, *Randell 289*, 17.xii.1985, (ADU, 2 sheets); beside road from Barrington Guest House to Dungog, *Randell 266*, 31.viii.1985, (ADU, 4 sheets); roadside Wauchope Township, *Randell 268*, 1.ix.1985, (ADU, 6 sheets); Buxner Flora Reserve, Coffs Harbour, *Randell 269*, 2.ix.1985, (ADU); between Bucca and Nova Glen, *Randell 271*, 2.ix.1985, (ADU); Myocum, *Kooyman s.n.*, 1986, (ADU, 2 sheets).

SOUTH AUSTRALIA: Morphettville, cult. home garden, *Randell 297*, 4.iv.1986, (ADU); cult. suburban garden, *J.R. s.n.*, 1.iv.1965, (AD); Medindie, cult. garden, *Waller 145*, 17.v.1976, (AD); cult. W.A.R.I., *Symon s.n.*, 1.v.1964, (AD); Tusmore, cult., *Symon s.n.*, 10.v.1966, (AD).

4. *S. bicapsularis* (L.) Roxb., *Fl. Ind. edn 2*:342 (1832).

Lectotype: LINN 528/10 (designated De Wit, *Webbia* 11:236 (1955), accepted by Brenan, *Flora of Tropical East Africa*, 71 (1967), Isley, *Mem. New York Bot. Gard.* 25:198 (1975) and Irwin and Barneby op cit., p. 401 (1982), not seen).

Synonyms and bibliography: see Irwin and Barneby (1982), p. 401.

Note

This name has been extensively used in Australia, almost entirely in error, for plants referable to both *S. pendula* var. *glabrata* and *S. corymbosa*. Only one plant truly referable to this species has been recorded in Australia [Pt Hedland, W.A., cult., *Stone s.n.*, -vi.1973 (PERTH)], and may be quickly recognised by the short pedicels (never more than 1.0 cm even in fruit) and folding habit of leaflets. Plate 3g-l.

However, there are in cultivation in Adelaide, S. Australia, a number of plants which may be of hybrid origin, as they appear intermediate in morphology between *S. pendula* var. *glabrata* and *S. bicapsularis* and have poor seed set and abnormal pollen. The origin of the form is not known, but the earliest record is of its cultivation in the arboretum of the 'W'afte Institute in 1938 (Symon, pers. comm.). As it is a handsome floriferous shrub, it may have been transported into cultivation in other parts of Australia. A full description is provided to allow identification of such specimens.

S. pendula × *bicapsularis* (?)

Description

Spreading shrub to 3 m; *leaves* including petiole 3-9 cm, glabrous; *leaflets* 3-4 pairs, broad lanceolate to broad elliptic, 1.0-1.5 cm apart on the rachis, the largest 2.5-5 x 0.8-2.0 cm, noticeably increasing in size from the base of the rachis, apex obtuse to acute, base unequal, veins impressed below, dark green above, paler below, margin yellow; *gland* 1 between lowest pair of leaflets, dark or green, erect; *petiole* 2-3 cm long, terete; *inflorescence* racemose, with 6-15 flowers; *peduncle* 2-4 cm; *pedicel* of open flower 1.0-1.5 cm long; *bracts* usually caducous; *flowers* to 3.5 cm diam.; *sepals* lanceolate to oval or obovate, unequal in length to

8 mm long; *petals* obovate, yellow, the longest to 15 mm; *androecium* of 3 adaxial staminodes and 6 or 7 fertile anthers, the 3 abaxial anthers the largest, to 7 mm long, the central anther (sometimes shrunk) on filament 4 mm long, the 2 plump lateral anthers on filaments 12 mm long, dehiscent by one U-shaped pore; *ovary* glabrous; *fruiting peduncle* to 4 cm long; *fruiting pedicel* 1.5-2.0 cm long; *pod* to 8 x 1.0 cm, not all ovules developing mature seeds so that this is sometimes misshapen; *seeds* dark green.

Notes

Differs from *S. pendula* because the leaflets fold forwards and downwards in sleep or on wilting, and from *S. bicapsularis* in the length of the pedicels. The poor seed set is in accord with hybrid origin as are the high frequencies of misshapen pollen grains (30-60%, Randell unpubl.)

Specimens seen (8 sheets):

SOUTH AUSTRALIA: Cult. Waite arboretum, *Wright s.n.*, 19.iv.1940 (AD); cult. Adelaide Botanic Garden, *Jaegermann 60*, 16.vi.1972 (AD); cult. University of Adelaide garden, *Randell 294*, -iv.1986 (ADU, 2 sheets); cult. University of Adelaide garden, *Randell 295*, -iv.1986 (ADU, 3 sheets); Dover Gardens, cult. home garden, *Randell 331*, -iii.1987 (ADU).

5. *S. corymbosa* (Lam.) Irwin and Barneby, *Mem. New York Bot. Gard.* 35:397 (1982).

Holotype: "cult. at Paris from seeds collected by Commerson on Bougainville's voyage, P-LA isotype P (hb. Poiret)" fide Irwin and Barneby, loc. cit.

Selected synonyms and bibliography

1. *Cassia corymbosa* Lam., *Encycl.* 1:644 (1785).

Description

Spreading shrub to 3 m; leaves 4-6 cm long including petiole, apparently glabrous; *leaflets* 2-3 pairs, narrow to broad lanceolate, 1.2-2 cm apart on the rachis, the largest 2.5-5 x 0.8-1.2 cm, increasing in size from the base of the rachis, apex acute, base unequal, slightly darker adaxially than abaxially; *gland* 1 dark and erect between the lowest pair of leaflets; *petiole* 2-3.5 cm long; *inflorescence* racemose, bearing 15-20 flowers; *peduncle* 2-3 cm long; *pedicel* of open flower 1.2-1.8 cm long; *bracts* caducous; *flowers* 2.0 cm in diam; *sepals* lanceolate to obovate, unequal in length, to 8 mm long; *petals* obovate, yellow, the largest to 1.5 cm long; *androecium* of 3 adaxial staminodes, and 6 or 7 fertile anthers, the 3 abaxial anthers the largest to 7 mm long, the central anther (sometimes shrunk) on filament 5 mm long, the 2 plump lateral anthers on filaments 10 mm long, dehiscent by 2 circular pores; *ovary* glabrous; *fruiting peduncle* 2.5-3.5 cm long; *fruiting pedicel* 2.0-2.5 cm long; *pod* to 15 x 1.0 cm curved; *seeds* 20-30 per pod. Plate 4a-g.

Distribution and ecology

In Australia, mostly cultivated. There is a single collection of a garden escape from New South Wales.

Notes

This is the only Australian species of ser. *Coluteoideae* to have the largest anthers biporose. The name has frequently occurred in nursery catalogues in Australia, usually for plants of *S. pendula*. It was identified by Irwin and Barneby as originating in South America, but was cultivated in Europe before 1800.



Plate 4. a-g, *S. corymbosa*. a, habit; b, pod (both from living material, cult. Adelaide Bot. Gard., Haegi 3906, AD); c, adaxial staminode; d, median anther; e, largest anther (lateral abaxial); f, central abaxial stamen; g, twin pores of largest anther (all anthers from Johnson & Briggs 3252, AD). h-n, *S. barclayana*. h, habit; i, pod; j, adaxial staminode; k, median anther; l, largest anther (lateral abaxial); m, central abaxial staminode; n, twin pores of largest anther (all from living material, cult. Adelaide Bot. Gard., Randell 333, ADU).

Specimens seen (10 sheets):

NEW SOUTH WALES: Tumby Umbi, roadside near Tuggerah Lake, Briggs 3252, 14.iii.1970, (AD); cult. Royal Bot. Gard. Sydney, Rodd s.n., 6.x.1968, (seed ex. Genoa, Italy), (AD).

SOUTH AUSTRALIA: cult. Waite Institute, Symon s.n., winter 1986, (ADU, 4 sheets); cult. Adelaide Bot. Gard., Randell 332, -v.1986, (ADU, 2 sheets); cult. Adelaide Bot. Gard., Haegi 3906, 18.iii.1986, (AD, ADU).

S. candolleana

The name *Cassia candolleana* has also appeared in horticultural catalogues in Australia. *Senna candolleana* (J. Vogel) Irwin and Barneby (p. 376, 1982) can be recognised by the following character suite: 4-8 pairs oblong-obovate, emarginate leaflets 2-4.5 cm long; petals 12-17 mm long; and only 6 fertile anthers, the central abaxial staminode on a filament 4 mm long, the 2 lateral abaxial anthers fertile biporose on filaments 7-10 mm long. The presence of *S. candolleana* in Australia has not yet been verified.

1b. Ser. *Basiglandulosae*

Senna Miller [sect. *Chamaefistula* (Colladon) Irwin and Barneby] ser. **Basiglandulosae** (Colladon) Irwin and Barneby, *Mem. New York Bot. Gard.* 35:405 (1982).

Lectotype: *Cassia occidentalis* L., syn. *Senna occidentalis* (L.) Link fide Irwin and Barneby loc. cit.

Synonyms and selected bibliography

1. *Cassia* L. sect. *Chamaesenna* Colladon ser. *Basiglandulosae* Colladon, *Hist. nat. méd. Casses* 107 (1816); DC. *Prod.* 2:497 (1825).

2. *Cassia* L. sect. *Chamaefistula* Colladon subsect. *Oncolobium* J. Vogel, *Gen. Cass. syn.* 10 (1837).

Lectotype: *C. occidentalis* L. fide Benth. p. 530 (1871); Irwin and Barneby loc. cit.

3. *Cassia* L. subgen. *Senna* (Miller) Benth. sect. *Oncolobium* (J. Vogel) Benth. in Martius, *Fl. Bras.* 15:110 (1870); Benth., *Trans. Linn. Soc. London* 27:530 (1871); Symon, *Trans. Roy. Soc. S. Australia* 90:79 (1966).

Description

Defined by Irwin and Barneby (1982) as having the petiolar gland either truly basal and juxtaposed to the pulvinus, or displaced towards the first pair of leaflets, obliquely-appendaged long anthers, and style dilated towards the apex. Stipules are usually acicular, or lanceolate, and caducous.

Key to the Australian species of ser. *Basiglandulosae*

1. Petioles 3-5 cm long; pods 10-20 cm long; ovules 40-100; exotics:
 2. Peduncles less than 0.5 cm long; leaves with sparse fine hairs 9. *S. occidentalis*
 2. Peduncles 0.5-3.0 cm long; leaves with dense setaceous hairs 10. *S. hirsuta*
1. Petioles 1.5-4 cm long; pods 4-9 cm long; ovules 20-30, natives:
 3. Glands of petiole squat, broader than tall:
 4. Leaflets 0.4-0.9 cm broad; pod 3-5 cm long 6. *S. barclayana*
 4. Leaflets 1.5-2.5 cm broad; pods 7.5-9 cm long 7. *S. planiticola*
 3. Glands of petiole erect, taller than broad 8. *S. clavigera*

6. *S. barclayana* (Sweet) Randell, comb. nov.

Basionym: *Cassia barclayana* Sweet, *Fl. Australas.* t. 32, (1828).

Lectotype: the cited plate "from the collection of Robert Barclay Esq., of Bury Hill and ... raised from seed from New Holland in 1824" fide Symon p. 89, 1966 (!in microfiche).

Synonyms

1. *Cassia lancifolia* Colla, *Herb. Pedem.* 281 (1831).

Holotype: "Grown from seed collected by Schultes collected in New Holland with that of *C. barrenfieldii* and *C. schultesii*." TO (lin photograph).

2. *Cassia schinifolia* DC. 7th Not. *Plantes rares jard. Genève* 35 (1825-1827).

Type: "of uncertain locality, the seed came to Geneva from Montpellier", not located. Equated with *C. barclayana* by Benth. p. 533 (1871) and Symon p.89 (1966).

3. *Cassia sophera* var. *schinifolia* (DC.) Benth., *Fl. Austral.* 2:283 (1864).

4. *Cassia sophera* L. var. *sophera* Benth., *Trans. Linn. Soc. London* 27:533 (1871) p.p. as for *C. sophera* var. *schinifolia* and *C. barclayana*.

5. *Cassia sophera* var. *barclayana* (Sweet) Domin, *Biblioth. Bot.* 89:792 (1926).

6. *Cassia occidentalis* var. *schinifolia* (DC.) De Wit, *Webbia* 11:258 (1955).

7. *Cassia barclayana* var. *barclayana* Sweet. Symon, *Trans. Roy. Soc. S. Australia* 90:89 (1966), p.p. except for *C. sophera* var. *clavigera*.

Description

Herb or shrub to 1.5 m tall; *stems* glabrous; *leaves* 8-12 cm long including petiole; *leaflets* 6-10 pairs, narrow elliptic to lanceolate, 1.0-1.5 cm apart on the rachis, the largest 2.5 x 0.4-0.9 cm, increasing in size from the base of the rachis but the terminals often shorter than the subterminals, apex acute to acuminate, base equal, glabrous, veins conspicuous below, olive green above, dull below; *gland* one, dark, broader than tall, concave, close to stem; *petiole* 1-2 cm long; *inflorescence* racemose bearing 6-10 flowers; *peduncle* 2-3.5 cm long; *pedicel* of open flower 1.2-2.0 cm long; *bracts* usually caducous; *flowers* 1.8-2 cm in diam. when open; *sepals* oval, subequal; *petals* obovate, yellow, to 1.2 cm long; *androecium* of 3 adaxial staminodes, 1 abaxial staminode, 4 median fertile beaked anthers and 2 larger (to 3 mm long) abaxial fertile anthers with pale recurved beaks on filaments 2 mm long; *ovary* sparsely hairy; *fruiting peduncle* 3-4 cm long; *fruiting-pedicel* 1.5-2.5 cm long; *pod* 3-5 x 0.6-0.9 cm, dark brown with conspicuous pale sutures; *seeds* dark, elliptic to oval. Plate 4h-n.

Distribution and ecology

Widespread and weedy in open forests of eastern northern New South Wales and southern Queensland. Now spreading to southern and western States. Map 2.

Notes

1. Differs from *S. clavigera* in the squat glands, absence of hairs, smaller leaves and recurved anther beaks.

2. Western Australian specimens are slightly atypical in having 9 pairs of very narrow leaflets. They represent a new record for Western Australia, but it is not clear if they are endemic or recently introduced weeds.

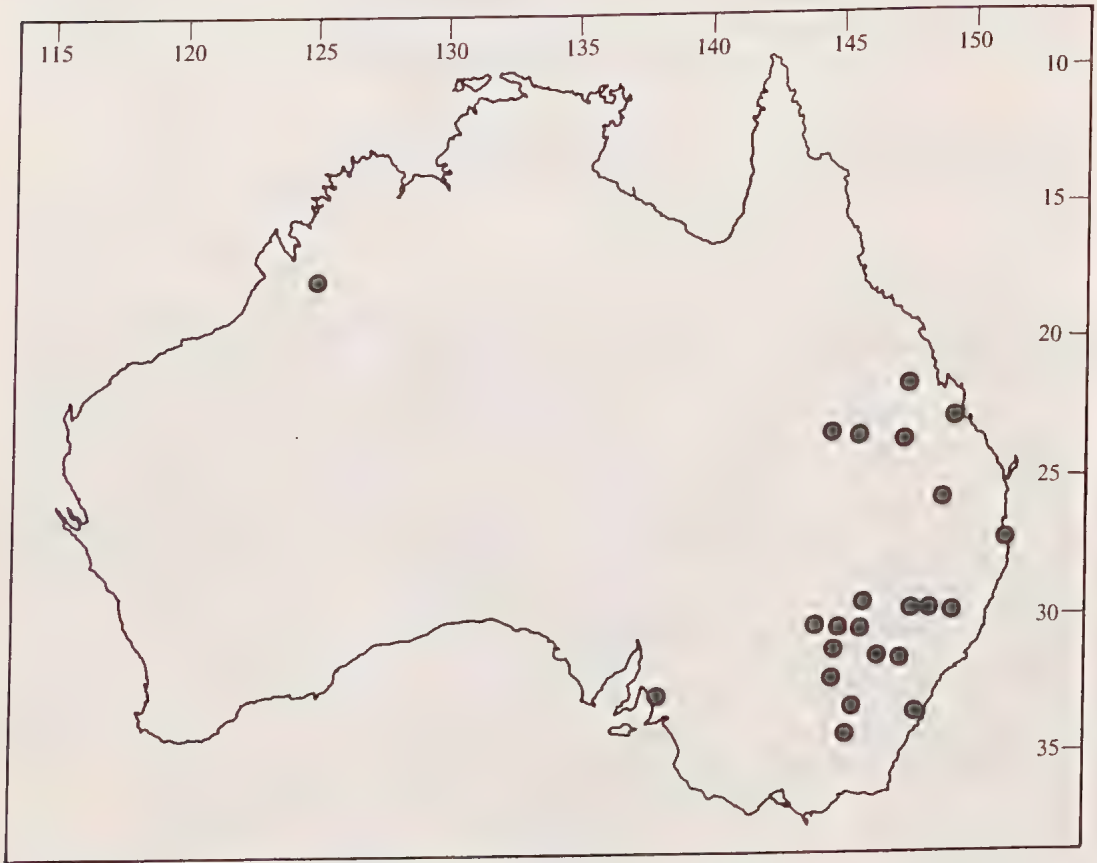
Selection of specimens examined (45 sheets seen):

WESTERN AUSTRALIA: Comballin, *Power* 726, -v.1970 (PERTH); Noonkanbah Crossing, *Royce* 6986, 12.v.1962 (PERTH).

QUEENSLAND: Upper Barcoo, *Miss Walker s.n.*, 1890 (MEL); between the Barcoo and the Roma, *Birch s.n.*, 1871 (MEL); Rockhampton, *O'Shanesy* 139, 20.viii.1867 (MEL, 2 sheets); Tambo Barcoo, *Schneider s.n.*, 1871 (MEL); Peak Downs, *Burkitt s.n., s.d.* (MEL); Mudflats, Moreton Bay, *Anon.* 157, 7.i.1867 (MEL); Greenswamps Rd, Chinchilla, *Hando s.n.*, 25.ii.1985 (ADU, 3 sheets).

NEW SOUTH WALES: Ingleburn, Railway Enclosure, *McBarron* 12034, 29.i.1966 (AD, 2 sheets); Glenlee near Menangle Pk, *McBarron* 16561, 17.v.1969 (AD); 2 miles SE Narrabri towards Boggabri, *Morrow* 46, 20.iii.1968 (AD); 32 km E Cobar on Barrier Highway, *Blaxell* 685, 16.xi.1971 (AD); Hermdale, between Nyngham and Cobar, *Howard* s.n., 25.xii.1962 (AD); Condumbul, *Filson* 668, 10.i.1959 (AD); Culcairn, *McBannon* 3024, 25.i.1949 (MEL); Moona Plains Walcha, *Crawford* s.n., 1884 (MEL); Namoi, *Musson* s.n., 1890 (MEL); Dubbo, *Boorman* s.n., -xii.1897 (MEL).

SOUTH AUSTRALIA: Riverton, *Dept. of Agriculture* 354, 24.iii.1971 (AD); Salisbury, *Symon* s.n., 25.xii.1954 (AD); Salisbury, *Kloot* s.n., 2.ii.1978 (AD).



Map 2. Distribution of *S. barclayana*.

7. *S. planitiicola* (Domin) Randell, comb. nov.

Basionym: *Cassia planitiicola* Domin, *Biblioth. Bot.* 89:791 (1926); Symon, *Trans. Roy. Soc. S. Australia* 90:91 (1966).

Holotype: "Locis graminosis in collibus. Rolling Downs inter opp. Hughenden et Cloncurry, Queensland." *K. Domin* 5027. PR 527594 (lin photograph).

Description

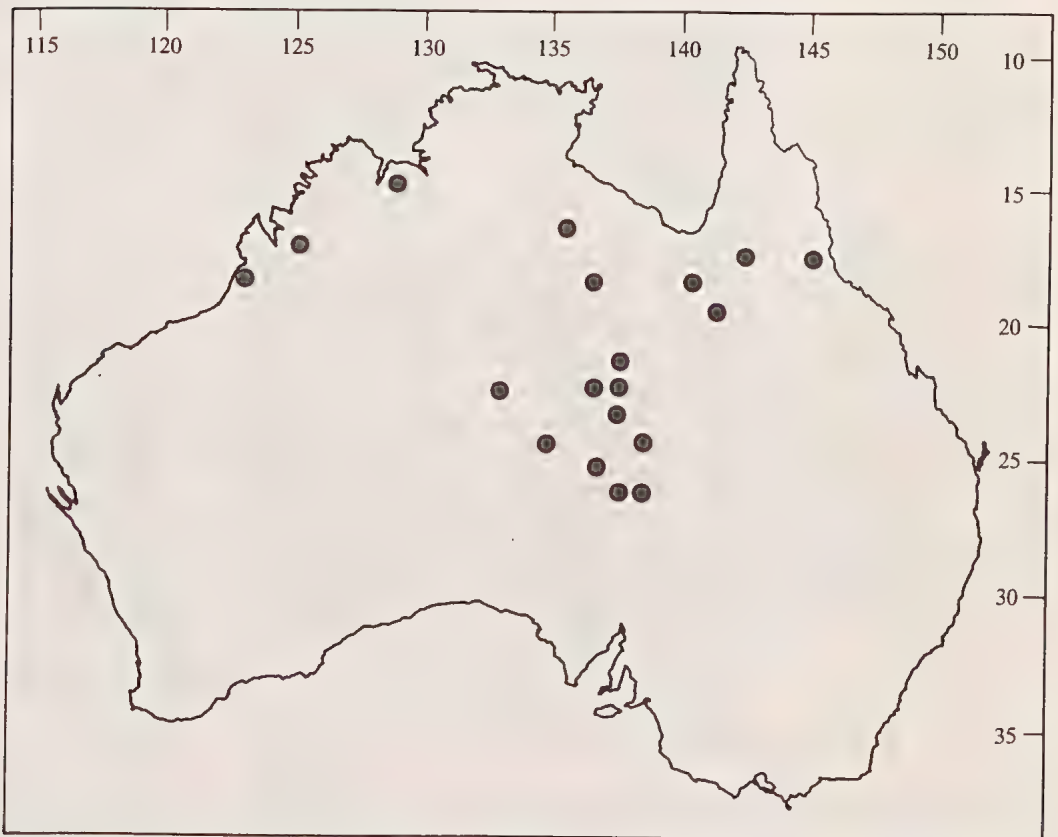
Shrub to 2.5 m; *leaves* 10-12 cm including the petiole, glabrous; *leaflets* 5-7 pairs, broad elliptic, 1.5-2.0 cm apart on the rachis, the largest 2-5.5 x 1.5-2.5 cm, almost equal in size, apex acute to acuminate, base unequal, glabrous, veins conspicuous below, olive green, concolorous; *gland* one, flat, broader than tall, 5-8 mm from the stem; *petiole* 2.5-5 cm long; *inflorescence*, racemose bearing 3-8 flowers; *peduncle* 2-4 cm long; *pedicel* of open flower 1.0-2.0 cm; *bracts* caducous; *sepals* lanceolate to elliptic, unequal in length, to 8 mm; *petals* elliptic to obovate, yellow, the largest to 1.2 cm long; *androecium* of 3 adaxial staminodes, 1 abaxial staminode, 4 median fertile beaked anthers, and 2 larger (to 4 mm long) abaxial fertile anthers with pale incurved beaks; *ovary* golden pilose; *fruiting peduncle* 1.5-4 cm long; *fruiting pedicel* 1.0-2.0 cm long; *pod* 7.5-9.5 x 0.8-1.1 cm, rich brown with broad paler sutures; *seeds* 20-40, dark, oval, wrinkled. Plate 5a-e.

Distribution

Widespread over subtropical Australia. Map 3.

Notes

Differs from both *S. barclayana* and *S. clavigera* in the longer pods.



Map 3. Distribution of *S. planiticola*.

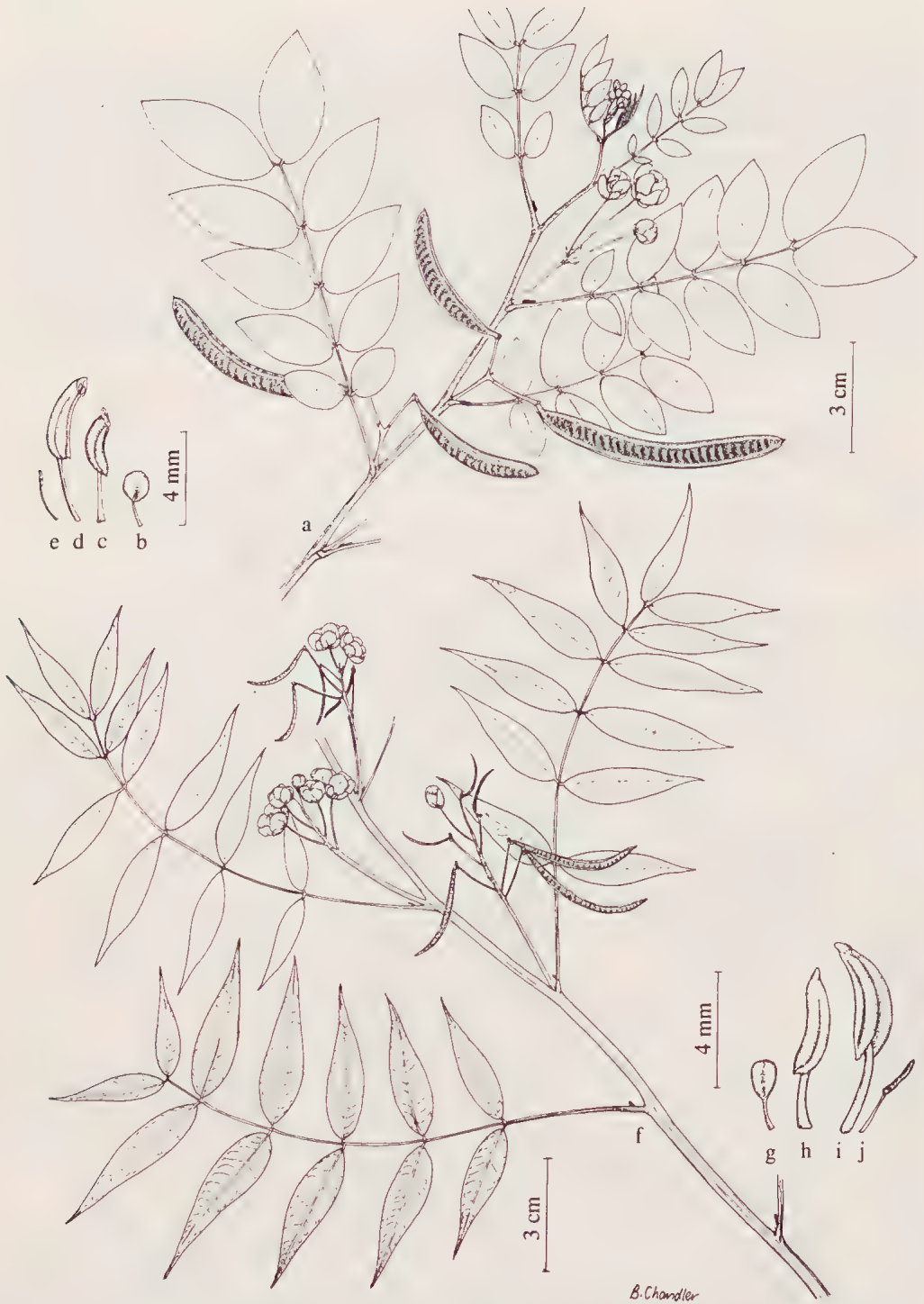


Plate 5. a-e, *S. planiticola*. a, habit (from Chippendale 7165, AD); b, adaxial staminode; c, median anther; d, largest anther (lateral abaxial); e, abaxial staminode (all from Chippendale 3979, AD). f-j, *S. clavigera*. f, habit (from Coveny 14419, AD); g, adaxial staminode; h, median anther; i, largest anther (lateral abaxial); j, abaxial staminode (all from Blaxell & Pickard 228, AD).

Selection of specimens examined (42 sheets seen):

WESTERN AUSTRALIA: Windjana Gorge, Napier Range, *Beaglehole* 47812, 22.viii.1947 (AD); Ivanhoe Station, Buttons Gap, *Jackson* 1022, 1.vi.1967 (AD); entrance to Buttons Gap, *Burbidge* 5194, 17.iv.1956 (AD, CANB); Phangoo Station, 20 km S Broome, *McCormick* s.n., 25.iii.1987 (PERTH).

NORTHERN TERRITORY: Finke River Mission, *Kempe* s.n., 1879 (MEL); Mt Sonder *Tietkins* s.n., 1889 (MEL); 10.2 miles SE Alexandria, *Chippendale* 7165, 19.vi.1960 (AD, MEL); 5 miles N Derwent Homestead, *Chippendale* 274, 7.ii.1955 (AD); Kulgera, *Chippendale* 3979, 14.x.1957 (AD); nr Wavehill Police Station, *Perry* 2253, 25.vi.1949 (AD, MEL); Hermannsburg, c. 110 km WSW Alice Springs, *Pink* 78, 23.xii.1930 (AD); Glen Helen, *Chippendale* 785, 4.ii.1955 (AD); Haast's Bluff, McDonnell Range, *Hill* 177, 16.iv.1911 (MEL).

QUEENSLAND: Gregory R., *MacGillivray* s.n., 27.vii.1928 (AD); Toorak Field Stn, S of Julia Ck, *Burbidge* 5331, 4.v.1956 (AD); Gilbert R., *Flecker* 4962, 21.iv.1938 (AD); Herbert R. to Carpentaria, *Lieut. Dittich* s.n., 1886 (MEL).

SOUTH AUSTRALIA: Mt Carmeena, Everard Range, *Krahenbuehl* 3944, 5.ix.1968 (AD); Musgrave Range toward Everard Range, *E.C. Black* s.n., 10.iv.1950 (AD); Robb Well, Everard Range, *Kalotas* 989, 3.xii.1981 (AD); Illibilli Well, Everard Range, *Beaglehole* 10172, 24.vi.1965 (AD); Wantapella Swamp, *Symon* 16, 27.v.1953 (AD); Pt Augusta, *Kain* 673, 13.vi.1962 (AD).

8. *S. clavigera* (Domin) Randell, comb. et stat. nov.

Basionym: *Cassia sophera* var. *clavigera* Domin, *Biblioth. Bot.* 89:792 (1926).

Holotype: "Queensland, A. Dietrich, PR. 527798" (! in photograph).

Synonyms

1. *Cassia sophera* var. *pubescens* Benth., *Fl. Austral.* 2:283 (1864).

Lectotype: "Broad Sound, R. Brown 101, 1802", BM lower specimen (! in photograph) lectotype here designated, isocototypes BM, K (! in photograph), MEL ! (2 sheets).

Syntypes: "Broad Sound Bowman" MEL, not seen; "Parramatta, Wools" MEL; "Ottleys Station, Leichardt", not seen.

2. *Cassia barclayana* var. *barclayana* sensu Symon, *Trans. Roy. Soc. S. Australia* 90:89 (1966) as for *C. sophera* var. *clavigera*.

Description

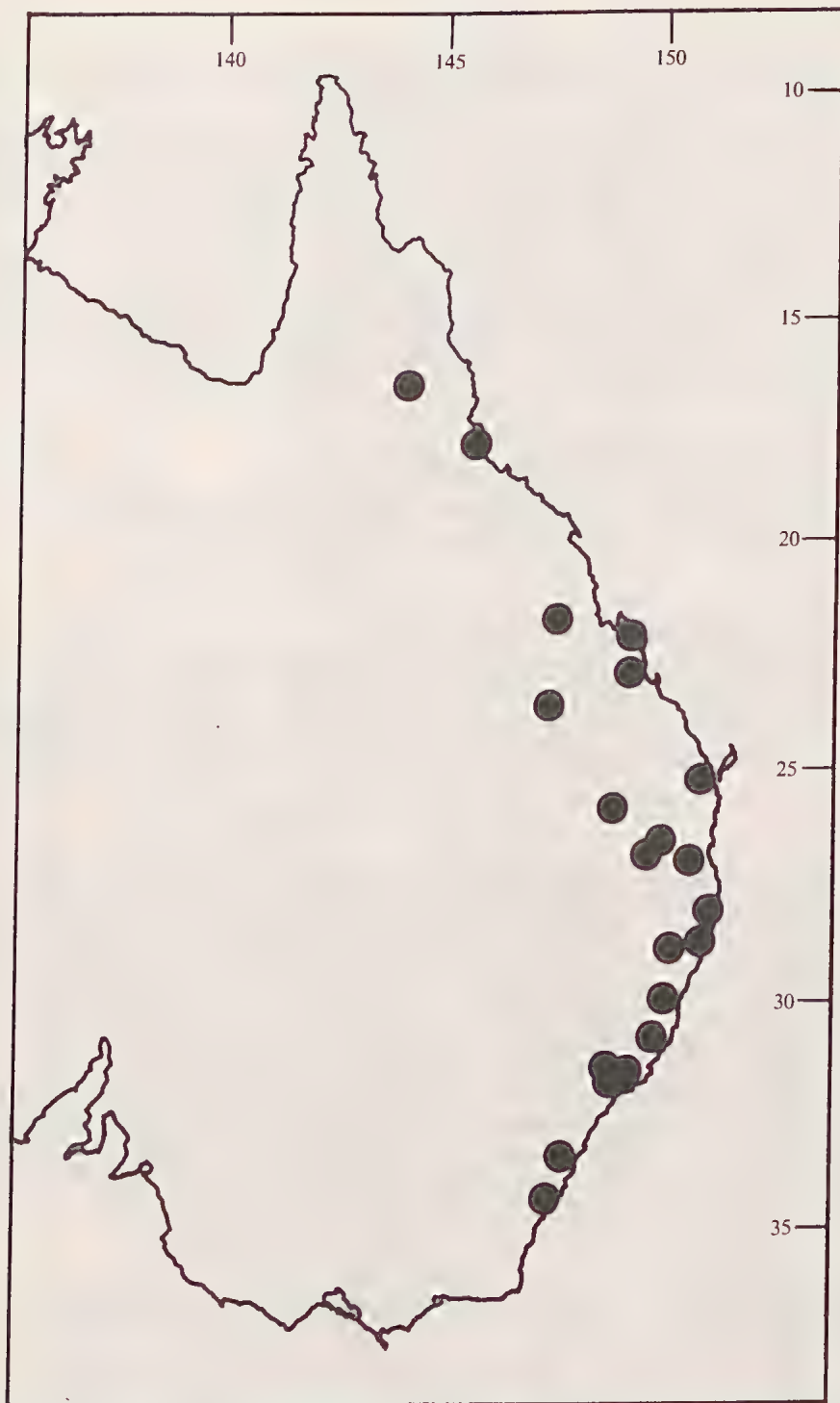
Herbs to 1.5 m tall; *stems* pubescent or not; *leaves* 10-12 cm long, including petiole; *leaflets* 4-7 pairs, narrow elliptic to elliptic, 1-2 cm apart on the rachis, the largest 4-7 x 1-2 cm, increasing in size from the base of the rachis but the terminals often shorter than the subterminals, apex acute to acuminate, base cuneate, slightly unequal, glabrous, or with scattered hairs on the lower surface, veins conspicuous below, dark green above and paler below; *gland* one, club-shaped, (taller than broad), dark, 5-8 mm from the stem; *petiole* 1.5-3.5 cm long; *inflorescence* racemose or paniculate 4-20 flowered; *peduncle* 2-4 cm long; *pedicel* of open flower 1.2-1.5 cm long; *bracts* caducous; *flowers* to 1.8 cm diam.; *sepals* subequal, oval to 0.8 cm long; *petals* obovate, yellow, to 1.0 cm long; *androecium* of 3 adaxial staminodes, 1 abaxial staminode, 4 median fertile beaked anthers and 2 larger (to 4 mm long) abaxial fertile anthers with pale incurved beaks on filaments 2 mm long; *ovary* sparsely hairy; *flowering peduncle* 3 cm long; *flowering pedicel* 1.5-2 cm long; *pod* 4-5 cm x 0.5 cm, dark brown with paler sutures, *seeds* oval, olive-green. Plate 5f-j.

Distribution and ecology

Apparently restricted to wet sclerophyll forests of eastern Australia. Perhaps weedy in nearby areas. Map 4.

Notes

Differs from *S. barclayana* in the erect glands, pubescent stems, larger leaves and incurved anther beaks.



Map 4. Distribution of *S. clavigera*.

Selection of specimens examined (42 sheets seen):

QUEENSLAND: Tanderrea, 45 miles SW Springsure, *Johnson 1301A*, 15.ii.1960, (AD); between Lotus and Marlborough, *Beaglehole 3577*, 27.vi.1955 (MEL, 2 sheets); Peak Downs, *George Burkill s.n.*, (MEL); Fraser Is., *Eaves s.n.*, 1874 (MEL, 2 sheets); Moggill, Moreton Bay, *Paddich(?) 317*, (MEL); Ipswich, *Nearnst s.n.*, (MEL); 43 miles SSW of Mt Garnet, *Lazarides 4211*, 27.ii.1954, (MEL); Baking Board near Chinchilla, *V. Hando no. 12*, 25.i.1976 (ADU).

NEW SOUTH WALES: near Cobbitty Trig, 5.5 km N Cobbitty, *Coveny 7432*, 12.iii.1976 (AD); Moonpar State Forest, *Pickard & Blaxell 228*, 18.iv.1969 (AD); Wherral Flat near Wingham, *Coveny 144119*, 11.i.1967 (AD); Richmond R., *Fawcett s.n.*, (MEL); Clarence R., *Wilcox s.n.*, 1875 (MEL); Shoalhaven Gullies, *Ferry 1865* (MEL); Williams R., Newcastle, *R. Brown s.n.*, 1802-1805, (MEL); roadside, 20 km N Gloucester towards Nowendoc, *Randell 290*, 17.xii.1985 (ADU).

SOUTH AUSTRALIA: Berri Nursery, *Gray s.n.*, 13.i.1972 (AD).

9. *S. occidentalis* (L.) Link, *Handbuch* 2:140 (1831).

Lectotype: "a cultivated plant, BM (hb. Clifford.)" not seen . . . designated Brennan, *Flora of Tropical East Africa* p. 78 (1967), accepted by Irwin and Barneby, *Mem. New York Bot. Gard.* 35:436 (1982).

Synonym: *Cassia occidentalis* L., *Sp.Pl.* 377 (1753); De Wit, *Webbia* 11:256 (1955); Symon, *Trans. Roy. Soc. S. Australia* 90:87 (1966).

Description

Foetid shrub 1-2 m; *stems* olive green with pale ribs; *leaves* including petiole 15-17 cm long, glabrescent; *leaflets* 3-7 pairs, broad elliptic to ovate, 1.5-3 cm apart on rachis, the largest 5-7 x 3-4 cm, increasing in size from the base of the rachis, apex acute to acuminate, base slightly unequal, very sparsely pubescent, midrib prominent below, immersed above, concolorous, olive green; *gland* 1, dark sessile, broader than tall, very close to stem; *petiole* 2-4 cm long; *inflorescence* racemose, 2-4 flowered; *peduncle* 0.2-0.5 cm; *pedicel* of open flower 1.0-1.5 cm; *bracts* caducous; *sepals* lanceolate, to 8 mm long; *petals* yellow, to 10 mm long; *androecium* of 3 adaxial staminodes, 1 abaxial staminode, 4 fertile median beaked anthers, and 2 large fertile beaked abaxial anthers 4 mm long on filaments 4 mm long; *ovary* densely pilose; *fruiting peduncle* 0.5 cm long; *fruiting pedicel* 0.8-1.0 cm long; *pod* 10-12 x 0.8-1.1 cm, golden brown with paler margins; *seeds* olive green, oval. Plate 6a-e.

Distribution and ecology

Now weedy in Queensland, Northern Territory and South Australia. Also recorded for New South Wales (Jacobs and Pickard, 1981) not seen. Map 5.

Notes

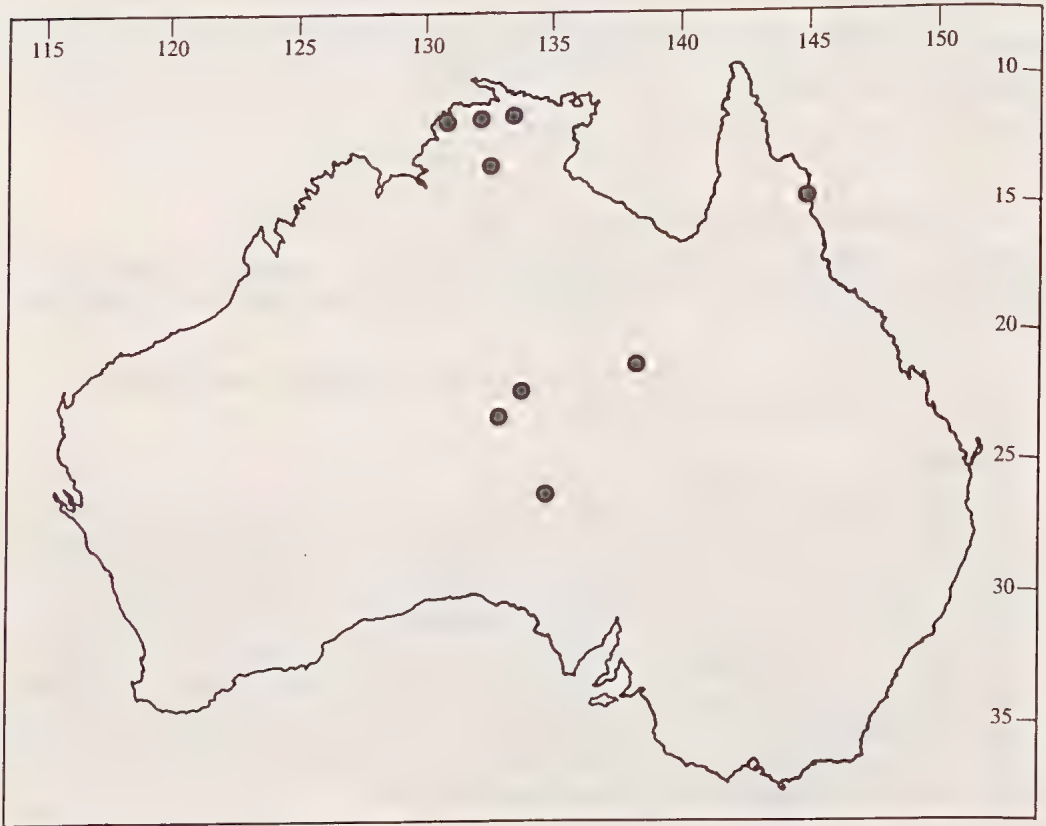
Described by Irwin and Barneby (op. cit) as 'now everywhere weedy in the New World, not demonstrably native but distributed throughout the American Tropics'. Also widespread in similar habitats almost throughout tropical Africa, India, Sri Lanka, Indochina, South China, Malesia, North Australia and east through Micronesia to Hawaiian Is. The plant has been given many names since it was first described (for full synonymy, see Irwin and Barneby (op. cit.) but in Australia has always been known as *Cassia occidentalis*.

Specimens seen (15 sheets):

NORTHERN TERRITORY: Tempe Downs Stn., ca. 170 km WSW Alice Springs, *Schneider s.n.*, 8.iv.1970, (AD); Santa Teresa Road, 13 miles SE Alice Springs, *Nelson 1609*, 19.xii.1967 (AD); near Oenpelli Mission, *Specht 1200*, 17.x.1948, (AD, MEL); 1 mile S Katherine on Stuart Highway, *Burbidge 5045*, 6.iv.1956, (AD); Fogg Dam area, 40 miles SE Darwin, *Chippendale 6185*, 18.v.1959 (AD); Kapalaga, Bullocky Point, *Dunlop 6126*, 13.iii.1982 (MEL).

QUEENSLAND: Georgina R., *Wilkinson s.n.*, 1893 (MEL); Endeavour R., *Persieh 1151*, 1883, (MEL); Endeavour R., *Persieh s.n.*, 1884 (MEL).

SOUTH AUSTRALIA: Todmorden Homestead, *Wigg s.n.*, 23.ii.1958, (AD); cult. Waite Institute, *Symon s.n.*, (AD, 3 sheets).



Map 5. Distribution of *S. occidentalis*.

10. *S. hirsuta* (L.) Irwin & Barneby, *Phytologia* 44:499 (1979); *Mem. New York Bot. Gard.* 35:425 (1982).

Holotype: "a plant cultivated at Hartekamp and described by Linnaeus BM (hb. Cliffort.);" fide Brenan, *Flora of Tropical East Africa*, p. 80, 1967; Irwin and Barneby (1979 & 1982).

Synonym: *Cassia hirsuta* L., *Sp. Pl.* 378 (1753); De Witt, *Webbia* 11:250 (1955); Symon, *Trans. Roy. Soc. S. Australia* 90:88 (1966).

Description

Herb or woody shrub 0.2-2.5 m, foetid, pubescent; *stem* grooved; *leaves* 10-16 cm long, including petiole; leaflets 2-6 pairs, ovate to obovate, the largest 4-9 x 2-3.5 cm, increasing in size from the base of the rachis, apex acute to acuminate, base unequal, villous on both faces,

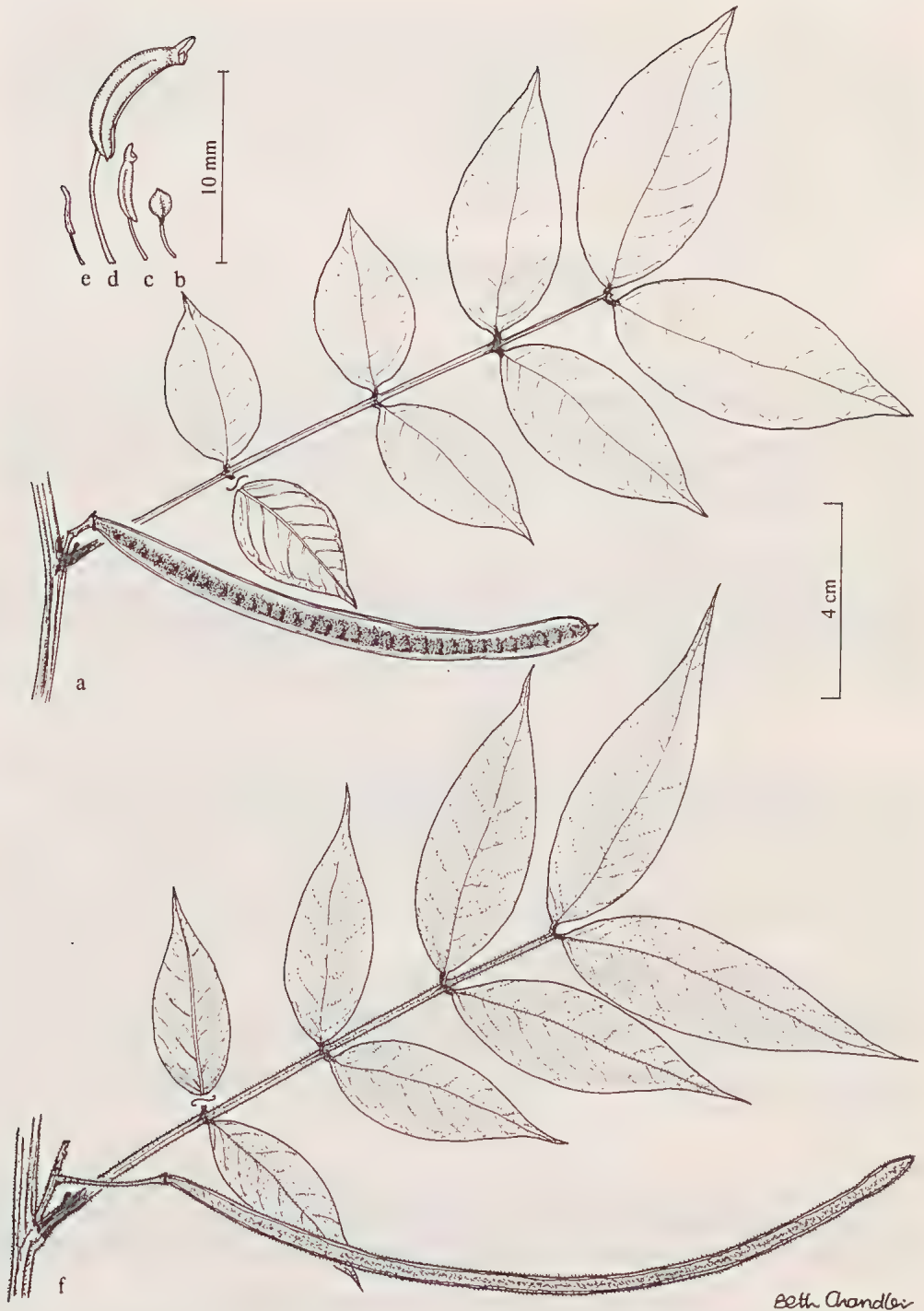


Plate 6. a-e, *S. occidentalis*. a, habit (from Symon s.n., 8.iii.1966, AD; pod from Maconochie s.n., 18.xii.1967, AD); b, adaxial staminode; c, median anther; d, largest anther (lateral abaxial); e, abaxial staminode (all from Symon s.n., 8.iii.1966, AD); f, *S. hirsuta*, habit (from Cabrera et al. 30258, AD, ex South America). Both habit drawings show abaxial surface of one disconnected leaflet.

nerves raised below, concolorous; *gland* 1, sessile, conical at the base of the petiole; *petiole* 4-6.5 cm long; *inflorescence* racemose, 2-5 flowered; *peduncle* 1.0 cm long; *pedicel* of open flower 1.2-2.0 cm long; *sepals* obovate, unequal in length, to 9 mm long; *petals* obovate, yellow, the largest 12-16 mm long; *androecium* of 3 adaxial staminodes, 1 abaxial staminode, 4 median fertile beaked anthers on short filaments, and 2 large abaxial fertile beaked anthers 7-8 mm long on filaments 5-6 mm; *ovary* villous; *fruiting pedicel* 1.5-2.0 cm long; *pod* 10-14 x 0.4-0.6 cm, pilose; *seeds* 50-90, dark. Plate 6f.

Distribution and ecology

Recorded as a weed in Queensland (Symon 1966).

Notes

Irwin and Barneby have described 7 varieties within this extremely variable species which was probably native somewhere in southern America, but is now 'prevailing weedy even where native' with 'extensions of range due to human interference.' It is a weed in Africa and South-east Asia. The Australian collections are variable and apparently include several of the varieties recognised by Irwin and Barneby. A full treatment of synonymy, typification and bibliography is given by Irwin and Barneby (p. 425, 1982).

Specimens seen (11 sheets: BRI):

QUEENSLAND: Roma, *Gould s.n.*, 26.v.1959; Danbulla, *Volck 2744*, vii.1960; Murray Upper, *Lavers s.n.*, 5.v.1961; 5 miles from Seaforth, *Onley s.n.*, 23.i.1963; Innisfail, *Dore s.n.*, 22.vii.1970; Atherton, *Hyland 5243*, 6.vii.1971; King Ranch near South Johnstone, *Teitzel s.n.*, 22.v.1978 (2 sheets); O'Reilly's Creek Rd., Lowood, *Dillewaard 546*, 14.iv.1981; East Funnel Ck, Sarina, *Thomas s.n.*, v.1984; Andromache, nr Proserpine, *Lade s.n.*, 15.vi.1987.

1c. Ser. *Trigonelloideae*

Senna Miller [sect. *Chamaefistula* (Colladon) Irwin and Barneby] ser. *Trigonelloideae* (Colladon) Irwin and Barneby, *Mem. New York Bot. Gard.* 35:237 (1982).

Lectotype: *Cassia tora* L., syn. *Senna tora* (L.) Roxb., fide Irwin and Barneby loc. cit.

Synonyms

1. *Cassia* L. sect. *Chamaesenna* Colladon ser. *Trigonelloideae* Colladon, *Hist. nat. méd. Casses* 95 (1816); DC., *Prod.* 2:493 (1825).

2. *Cassia* L. sect. *Prososperma* J. Vogel, *Gen. Cass. Syn.* p. 7, 9 & 23 (1837).

3. *Cassia* L. subgen. *Senna* (Miller) Benth. sect. *Prososperma* (J. Vogel) Benth. in Martius, *Fl. Bras.* 15:114 (1870); Symon, *Trans. Roy. Soc. S. Australia* 90:76 (1966) where *C. tora* L. was designated as lectotype.

4. *Cassia* L. subgen. *Senna* (Miller) Benth. sect. *Prososperma* (J. Vogel) Benth. ser. *Torae* Benth., *Trans. Linn. Soc. London* 27:535 (1871).

Description

Defined by Irwin and Barneby (1982) as having an herbaceous life-form, few ample leaflets, shortly pedunculate, 1-3 flowered racemes devoid of glands, and the peduncle usually shorter than the pedicels. In Australian species stipules are acicular to lanceolate and more or less persistent.

Key to Australian species of ser. *Trigonelloideae*

- Petioles 1.5-2 cm long; fruiting pedicels 1-2 cm long; anthers with short beaks; seed areole narrow, not longitudinal 11. *S. obtusifolia*
- Petioles 2-4.5 cm long; fruiting pedicels to 1.5 cm long; anthers truncate, beakless; seed areole broad, longitudinal 12. *S. tora*

11. *S. obtusifolia* (L.) Irwin and Barneby, *Mem. New York Bot. Gard.* 35:252 (1982).

Lectotype: 'the plate in Dillenius, *Hort. Eltham. Pl. Rar.* 71, t. 62 (1732) and typotype specimen OXF (hb. Dillen)' fide Brenan, *Kew Bull.* p. 250 (1958), not seen, accepted by Irwin and Barneby (loc. cit.).

Selected synonyms

1. *Cassia obtusifolia* L., *Sp. Pl.* 377 (1753); De Wit, *Webbia*, 11:254 (1955); Symon, *Trans. Roy. Soc. S. Australia* 90:93 (1966).
2. *Cassia tora* sensu Benth., *Trans. Linn. Soc. London* 27:535 (1871) p.p. as for *Cassia obtusifolia*.
3. *Cassia tora* var. *obtusifolia* (L.) Haines, *Bot. Bihar & Orissa* 304 (1922).

Description

Herb or subshrub 1-2 m tall; *leaves* 4-6 cm long including petiole; *leaflets* 2-3 pairs, obovate, 1.2-1.5 cm apart on rachis, the largest 4-5 x 2-3 cm, markedly increasing in size from the base of the rachis, apex obtuse, mucronate, base acute, unequal, with sparse short hairs below, veins impressed above, conspicuous below, dark green above and paler below; *glands* 1-2, erect, between lowest leaflet pairs; *petiole* 1.5-2 cm long; *inflorescence* racemose 1-2 flowered; *peduncle* very short, 2-4 mm long; *pedicel* of open flower 1.5-2 cm long; *bracts* lanceolate, ciliate, caducous; *sepals* elliptic, subequal, to 8 mm long; *petals* obovate, yellow, 8-10 mm long; *androecium* of 3 adaxial staminodes, 4 median fertile shortly-beaked anthers on short filaments, 3 larger (to 5 mm) abaxial fertile shortly-beaked anthers on longer (to 4 mm) filaments; *ovary* slightly pubescent; *fruiting peduncle* 2-4 mm long; *fruiting pedicel* 2-3 cm long; *pod* 12-18 x 0.3 cm, dark brown with paler line above the seeds; *seeds* rhomboidal, areole narrow (to 1 mm broad) diagonally across the face of the seed. Plate 7f-i.

Distribution and ecology

Irwin and Barneby (1982) give the distribution as 'probably native of the Americas but now (of) almost circumtropical dispersal' through North and South America and warm temperate Australia. It was first recorded as a weed in the Northern Territory in 1961, and in Queensland in 1963. Since then it has spread rapidly in Queensland and is now a serious problem in pastures, having been declared a noxious plant in 1981.

Specimens seen (9 sheets):

NORTHERN TERRITORY: 7.6 miles ENE Batchelor, *Chippendale* 7752, 18.iii.1961, (AD); Lee Point, 13 miles N Darwin, *Nelson* 1157, 13.vi.1964 (AD); Kapalga, *Collins B.C.* 383, 27.iv.1977 (AD); South Alligator Crossing, 97 km NE of Pine Ck, *R.M. Barker* 514, 9.v.1983, (AD); East Point, Darwin, *Robinson and Nelson* 1060, 8.vi.1964 (AD).

QUEENSLAND: Roadside, Claudie R. Crossing, Iron Range National Park, *E.L. Robertson s.n.*, 18.viii.1986 (ADU, 3 sheets); Utchee Ck, *Bailey* 14, 18.vi.1963 (BRI).

12. *S. tora* (L.) Roxb., *Fl. Ind. ed. Carey* 2:340 (1832).

Lectotype: "the type of Flora Zeylanica No. 152, which is a specimen in the Hermann Herbarium at the British Museum (Natural History)" fide Brenan, *Kew Bull.* p. 250 (1958) not seen.

Synonyms (based on the list of De Wit, 1955)

1. *Cassia tora* L., *Sp. Pl.* 376 (1753); De Wit, *Webbia* 11:276 (1955); Brenan, *Kew Bull.* 248 (1958); Symon *Trans. Roy. Soc. S. Australia* 90:92 (1966).

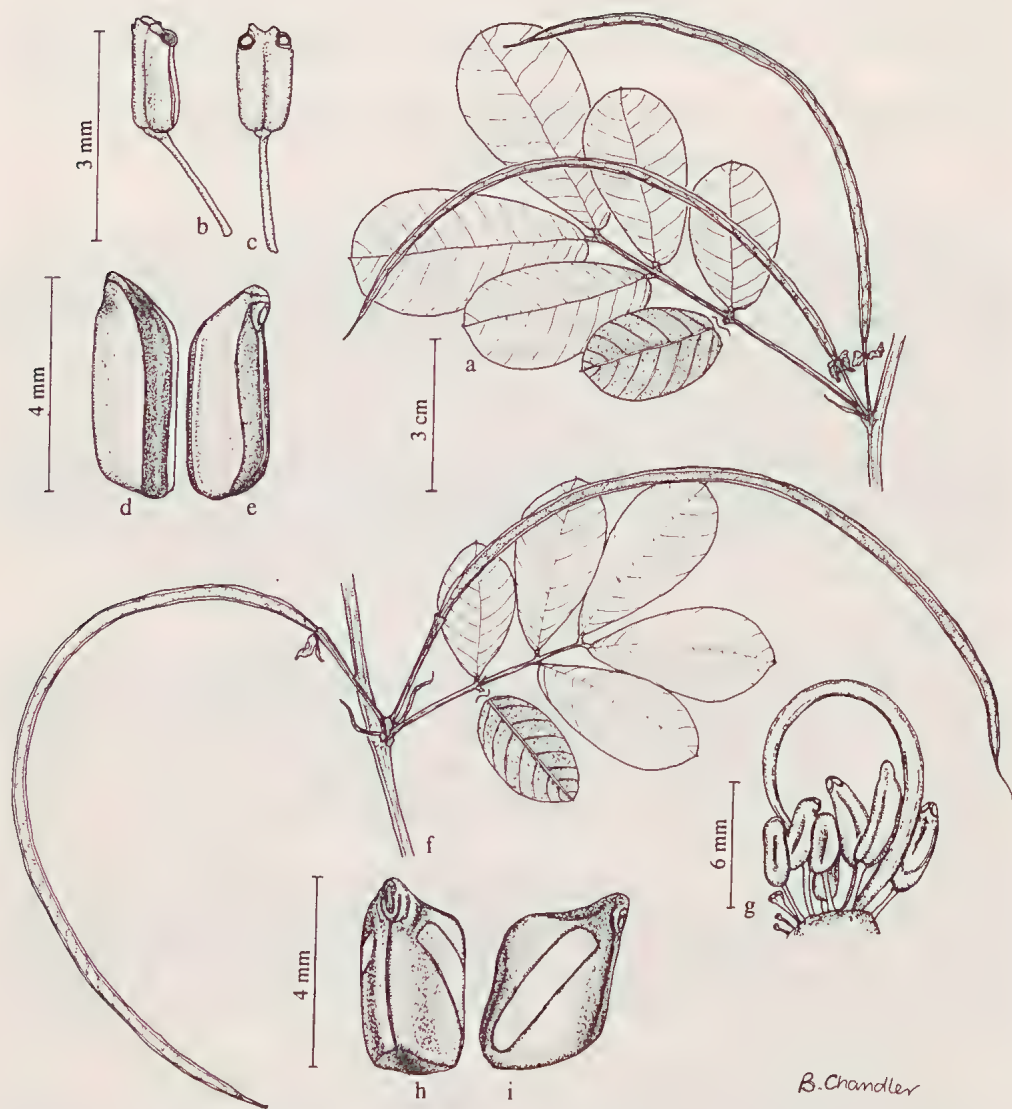


Plate 7. a-e, *S. tora*. a, habit (from Hyland 8786, AD); b & c, isolated anthers showing truncate tips; d & e, seed, two views showing broad longitudinal areole (anthers and seed from Everist 5159, AD). f-i, *S. obtusifolia*. f, habit; g, androecium showing 3 abaxial beaked anthers (both from R.M. Barker 514, AD); h & i, seed, two views showing narrow transverse areole (from Dutton & Taylor 6175, AD). Both habit drawings show adaxial surface in one disconnected leaflet.

2. *Cassia tala* Desvaux., *Journ. Bot. (Morot)* 3:73, t. 73 (1814).

Type: not determined.

3. *Cassia gallinaria* Colladon, *Hist. nat. méd. Casses* 96 (1816).

Type: not determined.

4. *Cassia borneensis* Miquel, *Anal. Bot. Ind.* 1:9 (1850); Merrill, *Bibl. Enum. Born. Pl.* 300 (1921).

Type: not determined.

5. *Cassia tora* var. *borneensis* Miquel, *Fl. Ind. Bat.* 1:95 (1855).

Type: not determined.

6. *Emelista tora* Britton & Rose, *Bot. Porto Rico* 5:371 (1925); Britton & Rose, *N. Amer. Fl.* 23:242 (1930).

Description

Herb or subshrub to 0.5 m tall, sometimes sparsely hairy on leaves and stems; *leaves* 5-6 cm long including petiole; *leaflets* 2-3 pairs, obovate, 1.0-1.5 cm apart on rachis, the largest 2.5-5.5 x 1.0-3.5 cm, increasing in size from the base of the rachis, apex obtuse or rounded, sometimes with a very short mucro, base very unequal, sparsely pubescent, veins conspicuous below, green above, paler below; *glands* 1-2, erect, sometimes pointed, between the leaflet pairs; *petiole* 2-4.5 cm long; *inflorescence* racemose, 1-2 flowered; *peduncle* 0.2-0.4 cm long; *pedicel* of open flower 1.0 cm long; *bracts* caducous; *sepals* broad elliptic to obovate, 0.5 cm long; *petals* obovate, yellow, 0.8-1.0 cm long; *androecium* of 3 adaxial staminodes (rarely these fertile and resembling the medians and then the androecium of 10 fertile anthers), 4 median fertile truncate anthers and 3 abaxial slightly larger fertile truncate anthers; *ovary* slightly pilose; *fruiting peduncle* 0.2-0.4 cm long; *fruiting pedicel* 0.8-1.0 cm long; *pod* 12-18 x 0.2-0.5 cm, curved, dark brown with paler sutures; *seed* twice as long as broad, areole longitudinal, almost as wide as the seed. Plate 7a-e.

Distribution and ecology

Sparsely naturalised in tropical Northern Territory and Queensland, sometimes in rainforest.

Notes

In gross morphology very similar to *S. obtusifolia*. Field identification must rely on petiole length (long in *S. tora*) and pedicel length (short in *S. tora*). Closer examination can utilise characters of the anther beaks (absent in *S. tora*) and seed areole (broad, longitudinal in *S. tora*; narrow and displaced from the longitudinal in *S. obtusifolia*), characters first emphasised by De Wit (1955), and Brenan (1958).

Because of the morphological similarities between these last taxa, they have been the subject of much discussion among taxonomists. It now seems reliably established that *S. obtusifolia* is native to South America, and has been transported as a weed to tropical areas of Africa, Asia and the Pacific (Irwin and Barneby p. 252, 1982). Similarly it seems highly probable that *S. tora* was native somewhere in the Asian-Pacific region and has been transported as a weed to Africa and Australia (Brenan 1967, Vatsavaya and Rama Rao 1986, Symon 1966). The suite of diagnostic characters first suggested by De Wit (1955) and amplified by Brenan (1958), have proven reliable in both Australian and Indian materials (Randell, unpubl. and Vatsavaya and Rama Rao 1986). In addition Indian studies have reported differences in parameters such as height, dry weight of root, pod length, number of seeds per pod, germination percentage (Singh 1968), certain secondary metabolites (Nageshwar et al. 1984), and leaf epidermal features (Mathur 1985 cited by Vatsavaya and Rama Rao 1986). In the light of such extensive differences, it is desirable to treat the two taxa as separate species.

Specimens seen (5 sheets):

NORTHERN TERRITORY: Pt Darwin, *Holtze s.n.*, 1888 (AD, MEL).

QUEENSLAND: East Palmerston, about 20 miles SE Millaa Millaa, *Everist 5159*, 29.v.1952 (AD, BRI); Whyanbeel, *Hyland 8786*; 13.v.1976 (AD).

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